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1882

THE ARTIZAN.

A MONTHLY JOURNAL OF

THE OPERATIVE ARTS.

Edited by the Artizan Club.

VOLUME THE FIRST.

[No. 1-12]

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1844.

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HASTIE'S LATHE & SCREW CUTTING ENGINE.

Fig. 1.

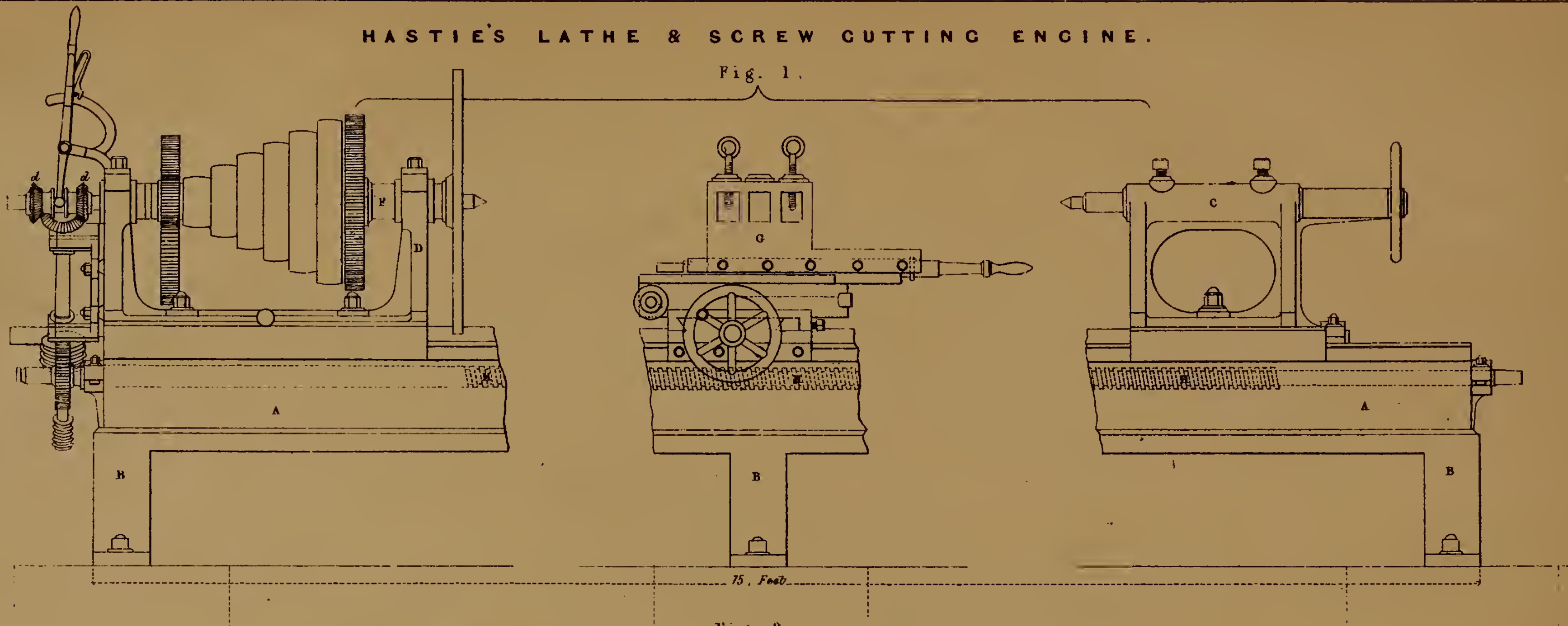
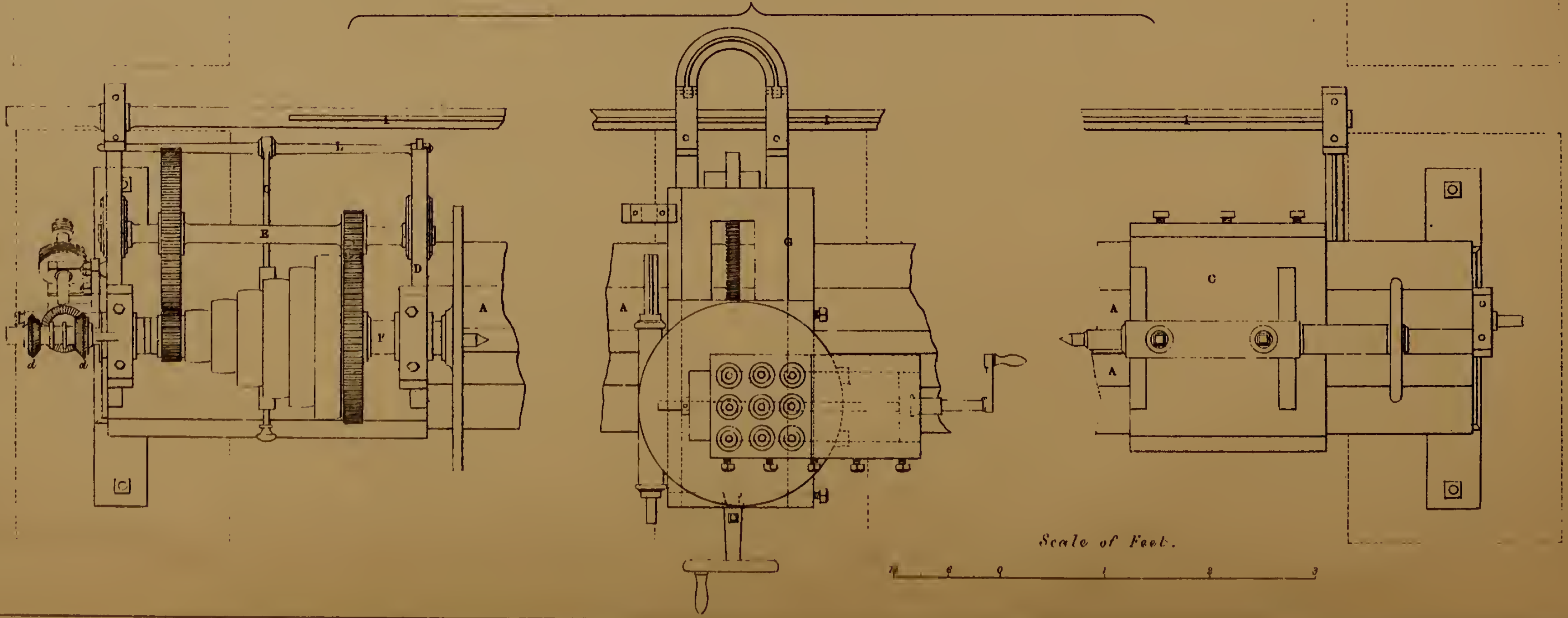


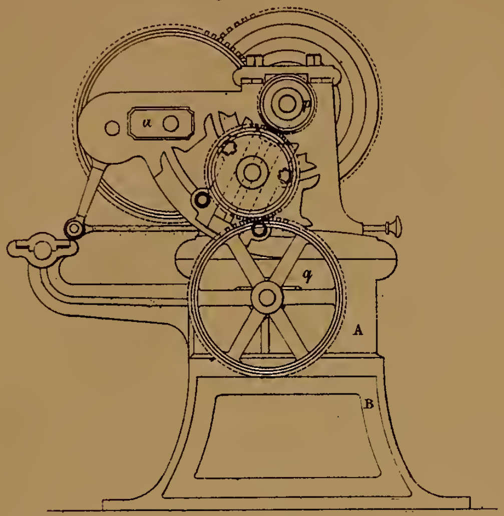
Fig. 2.



J R Jobbins, Litho 3, Warwick Cᵗ

HASTIE'S LATHE & SCREW CUTTING ENGINE.

Fig. 3.



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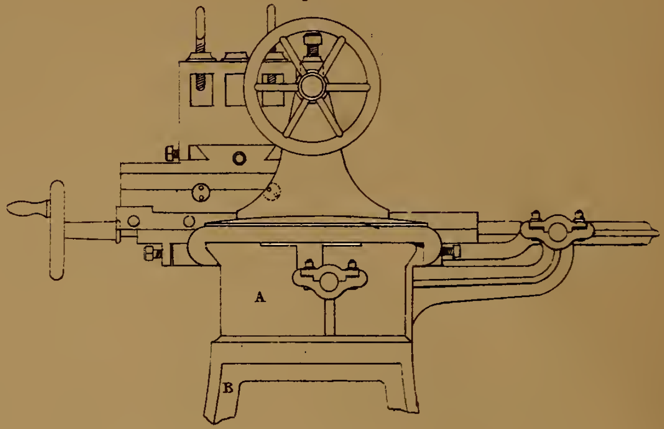

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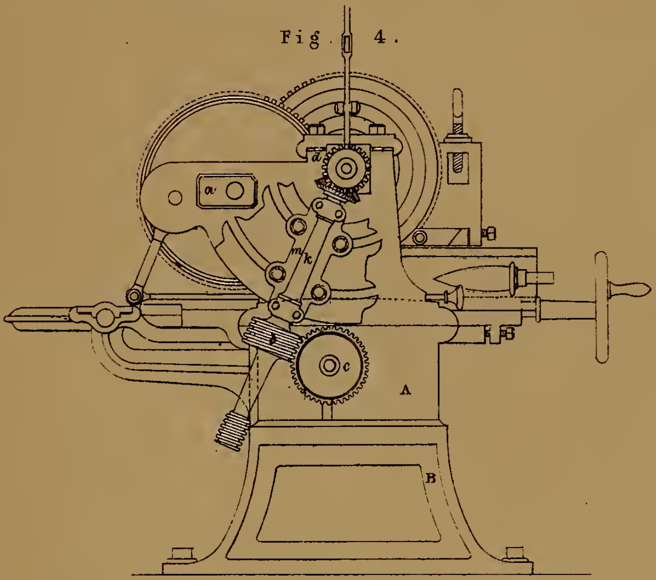

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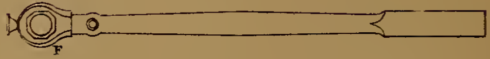

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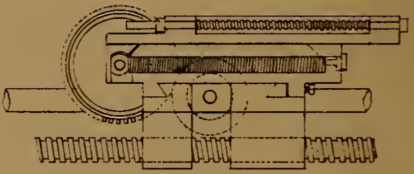

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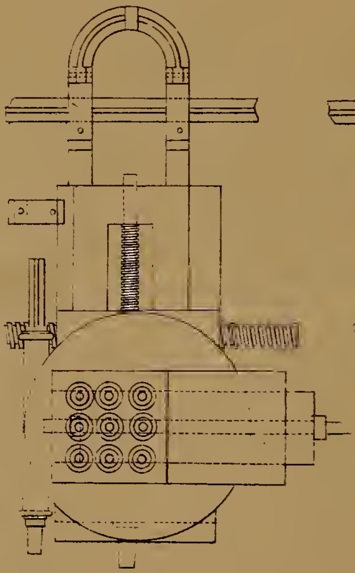

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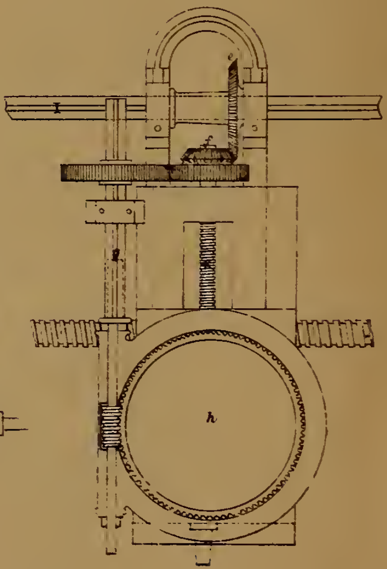

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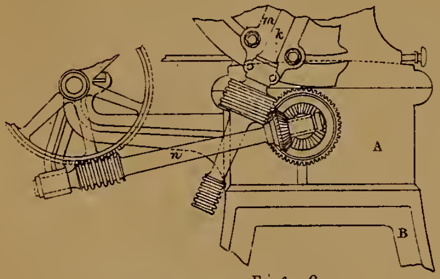

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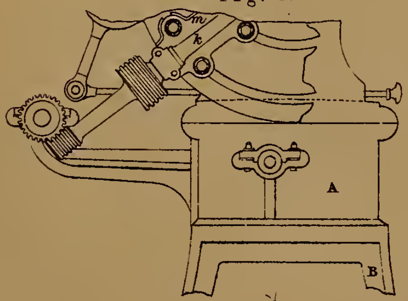

Scale of Feet.

12 6 0 1 2 3 4

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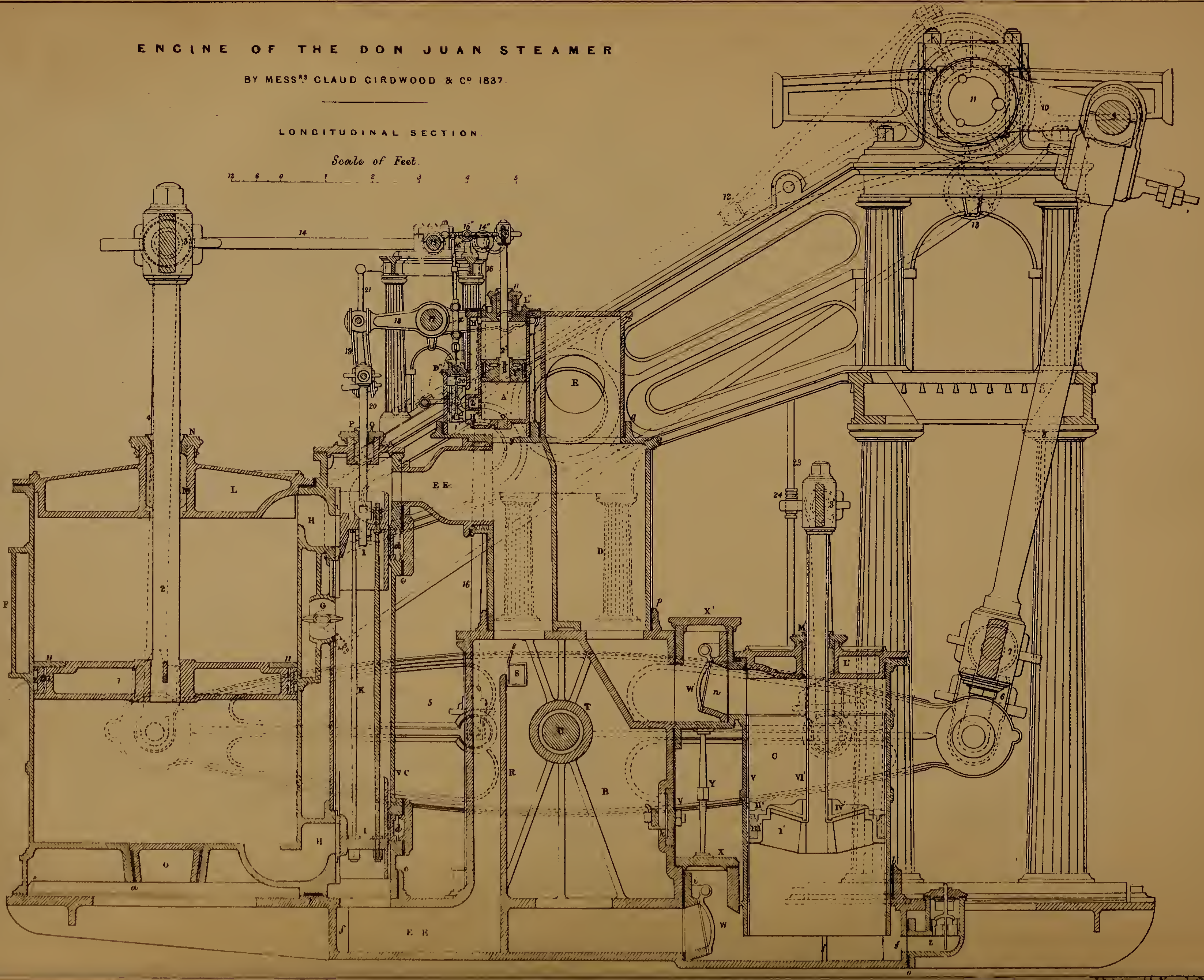
ENGINE OF THE DON JUAN STEAMER

BY MESSRS. CLAUD GIRDWOOD & Co. 1837.

LONGITUDINAL SECTION.

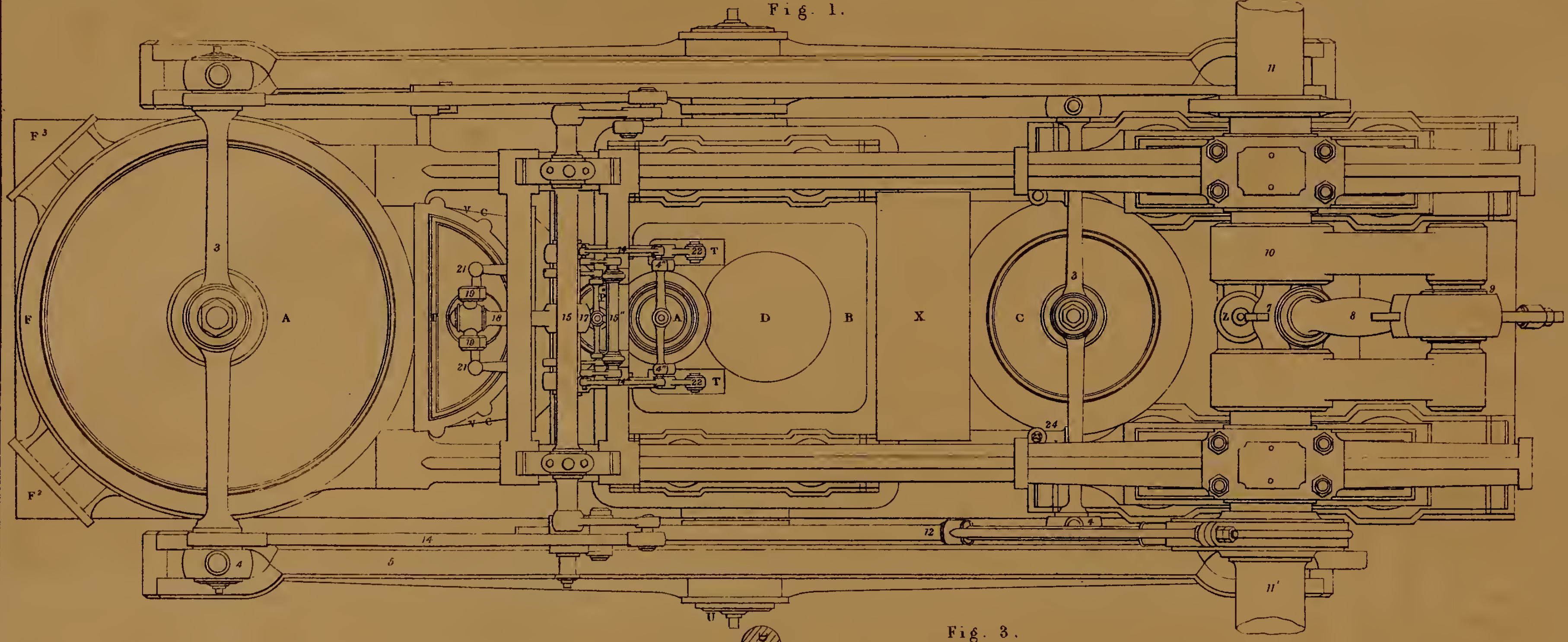
Scale of Feet.



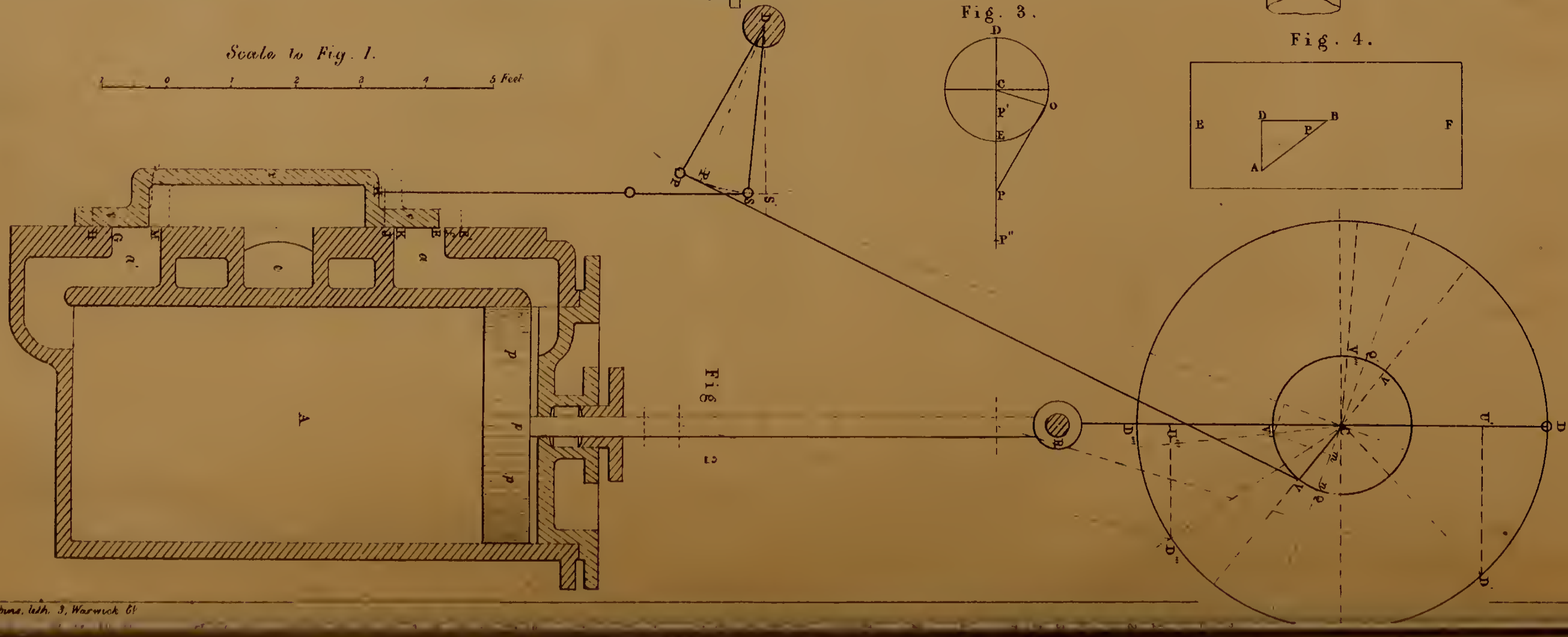
J. R. Jobbins, del. Norwich Ct

PLAN VIEW OF THE ENGINES OF THE DON JUAN.

Fig. 1.



Scale to Fig. 1.



J R Jobbins, lith. 3, Warwick Ct

THE ARTIZAN.

No. I.—JANUARY 31st, 1843.

A PREFACE!!!!

Art. I.

(*Scene, the Club-Room.*)

Gray. 'Faigs, it 'll no be written by me. Sauf us, div ye think I could sit deleeberately doun an' weave a wab o' lees to juggle the siller oot o' honest folk's pouches? It's contrair to the ten commandments; an' if I escapit the tredmill, I wadna escape the nichtmeer, an' that's far waur:—fechchtin' an' gruein' in your sleep as gin ye were fa'in' intil a coal-pit, or sailin' oot owre the Niagawra, or bein' cairted awa to the gallows knowe.—Na, na, siccan tricks are no canny. Great exertions, sair expense, unrivalled attraction, gawlaxy o' talent—a Preface is aye made up o' sich interjections, an' wha believes a word o' them a'? Prefaces are but a worn-oot device o' the arch enemy—a kin' o' impotent thimmel-riggery, indicatin' a want o' wut as weel as a want o' honesty.

Sir Jonah. A caricature—not a portrait. Why may not the truth be as well told in a Preface as in any other species of composition?

Gray. Because the verra aim an' intent o' a Preface is to disguise the truth. If it binna for that purpose, what's the use o't ava?

Sir Jonah. In our case it would simply be to inform our friends of the plan upon which we intend to proceed; to explain to the public in what exigencies the work has originated—

Gray. An' neither freens nor public care a preen's point aboot either. If the book be a gude book, it'll thrive; if a bad book, it'll be—(Echeh, Echeh.)—Ay 'twill, so will it. An' it's little a Preface can dae to secure the ae doom, or avert the ither. Folk 'll only speer if a ray frae the urn o' genius irradiates your pages, and if they are unafflicted wi' the usual proportion of Bawlaam.

Montgomery. Precisely so; the public is wonderfully quick in discovering the true character of any periodical; and the muddiest and obscurest dunces are always the most ready to promise and profess.

Gray. I wush, sir, ye'd spoot us something in the Preface line, accordin' to some o' the best modern resates; for I want to hae a bit nod.

Sir Jonah. That a periodical addressing itself to the numerous artizans engaged in the various branches of those operative arts which constitute the basis of this country's greatness, remains even yet an unsupplied desideratum, is a truth which admits neither of concealment nor refutation; and it is equally undeniable, that we alone, of all literati or artificers, are capable of removing such a stigma from the land. In the accomplishment of this task, we are prepared, of course, to display talent the most transcendent; consummate mechanical proficiency both in theory and practice; information profound and extended, derived from a familiarity with the chief aspects of art and nature; imagination brilliant and vigorous as a seraph's wing; and genius which drowns the glimmer of all rival lights in the flood of its own ineffable effulgence.

Gray. Stop, stop! I canna steek my een for lauchin'. Hech, sirs, thae Preface folk wad surely never try their hauns again gin they only heerd your gauns on. Hoo mony poet pooer could ye work up till at the true frenzy pressure?

Montgomery. The Atlantic never spouted more majestically.

Sir Jonah. Gardiner has been in sad tribulation respecting a Preface; and, after several ineffectual attempts to hatch one himself, has applied to three eminent poets of his acquaintance, who have agreed, for a valuable consideration, to concoct a Preface in rhyme—or, at least, some sort of dirge or carol, which may stand in the stead of one.

Gray. The stipid cretur! an' wha are the poets? I ken o' nane bauld eneuch to write for us forbye Tammas Cammal, Tammas Muir, an' Christopher North.

Montgomery. Or Wordsworth, Southey, and the Pelican.

Sir Jonah. The first lyrist is the poet of Mr. Robert Warren; the second, the poet of Mr. Professor Brown; and the third, the poet of Mr. Mordecai Moses.

Gray. Did I ever hear the likes o' that! An' the cost?

Sir Jonah. A shilling each, and a pot of porter. I have the verses in my pocket, and, before putting them into the fire, may as well read them aloud.—(*Reads.*)

A PUBLISHER'S CAROL FOR THE 31st OF JANUARY.

HUMBLY INSCRIBED TO A BREATHLESSLY EXPECTANT UNIVERSE.

1.

(*Mr. Robert Warren's Poet.*)

This is the day which gives to light
The graces of your infant king,
In majesty of beauty bright,
Beyond e'en hope's imagining;
The day when like the floods in spring,
My till shall spurn its wonted span—
A silver ocean murmuring
The praises of the Artizan.

Gray. Smells unco o' the bleckinin'.

2.

(*Mr. Professor Brown's Poet.*)

O bless with me the hour when first
The Artizan his sceptre swayed;
When on a darkling world he burst
Like lightning on the forest glade:—
Yet some who wander in the shade
Have sought my fealty to trepan;
But no—I only smiled and said,
"Ye are not like the Artizan."

Montgomery. In the true barbaric taste—yet a passable stave for a shilling.

3.

(*Mr. Mordecai Moses' Poet.*)

Illustrious power! I could not tell
The hopes and love I bring to thee,
Though every flower in yonder dell
Changed into burning words for me.
But oh! my heart bounds rapidly,
And well may'st thou its language guess;
Each pulse tumultuous throbs for thee,
And every throb is happiness.

Gray. Weel dune the tyler! the cretur has actually some sensibeelity, let-a-be considerable lyrical pooer. Faigs, I back the tyler against——

(*Enter Printer's Devil.*)

THE PREFACE.

Gray. The imp o' daurkness.

(*Curtain falls.*)

SCENE BEHIND THE SCENES,

(*by poetic license.*)

Gardiner (*whispering.*) How much have you got noted down?

Reporter (*whispering.*) About a page.

Gardiner. That's enough. I hope there's no treason in it; nothing against Church or State, or anything to give rise to the *scandalum magnatum.*

Reporter. Nothing. It's all innocent nonsense.

Gardiner. But for this device, we should have been without a Preface, and a book without a Preface is just as great an absurdity as a man without a head. (*Beckoning the devil.*) Take this and cut. (*Soliloquizing,*) O, the untractable natures of men of genius!

(*Left musing.*)

ART. II.—DR. LARDNER AND ATLANTIC STEAM VOYAGING.

THE unprecedented impetus the arts have experienced since the commencement of the present century, renders the consideration of their probable condition in another fifty years a question which no imagination can hope to compass. Speculation itself recoils from an inquiry, where the very foundations upon which any opinion might be based are themselves in a state of transition—where the revelations of science are perpetually overturning the fabric of received opinions, and where the difficulties, esteemed insuperable to-day, become easily surmountable to-morrow. Every accession to our knowledge is fraught with such important analogies, and becomes susceptible of so many unanticipated applications, that it would be difficult to assign the limits of its value, or to predict the consequences of its realization. Discoveries, apparently destitute of promise, become the genesis of a cycle of wonders; and it is the happy prerogative of scientific progress, that failure as well as success shall be capable of ministering to its acceleration. The torrent, which sweeps away the gorgeous palace or the stately pyramid, scatters upon the shore materials for a fabric of still greater magnificence. Many of the miracles of mechanical combination which constituted the glory of the by-gone generation, have already passed into oblivion; and the time is, perhaps, not far distant, when the records of history will be the only memorial of those triumphs of ingenuity which now command the world's homage, and minister to the world's enjoyment. In the world of art, as in that of nature, maturity of growth is often followed by rapidity of declension; and excellence seems only to be attained, in order that it may be supplanted by something more excellent still.

The wonderful revolution in the means of transit both by land and water, which has distinguished the present century, has mainly resulted from the successful exercise of British energy and British skill. The steam-engine, by which those wonders have been principally accomplished, is an invention essentially of British origin, as well as of British developement. The creation, in the first instance, of British genius, it has been fostered by British ingenuity, and nourished by British capital, until it has risen to a stature of which Britain may well be proud, and rendered benefits for which the world may well be grateful. The most laborious, the most versatile, the most obedient of servants, it is at the same time the most powerful and efficient; and, in the extension of its energies to nautical purposes, promises to be productive of benefits which past experience has neither fully exemplified nor adequately foreshadowed. Every line of safe and commodious communication between nation and nation, is a channel through which charity, improvement, and mutual benevolence will flow; and these benign influences must, in due season, chase away the darkness of tyranny and superstition, and quicken into life and beauty the desolate wastes of a heathen world. Among the blessed effects of this consummation, the bonds of the slave will become powerless, and the rod and the idol be unheard of for evermore: the zealot's fire will wax dimmer and dimmer, and the oppressed and the ignorant be illuminated and disenthralled: and the approach of that happy period when a pure faith and a lively charity shall cover the earth as a girdle—informing the untutored, softening the ungentle, and exalting the good; when the gorgeous East shall no more shower on her kings *barbaric* pearls and gold, and the West rise to greater triumphs than any she has hitherto won;—may be referable to the achievements of modern ingenuity, in the gradual approach to perfection of this its most stupendous monument.

But while we would desire to render all dutiful allegiance to the majesty of steam, and although we believe the powers of steam agencies to be such, that there is no voyage unaccomplishable by their instrumentality; we disclaim all participation in the inference, that enterprises in steam navigation, involving the performance of voyages of unusual length, must consequently be successful. Success is a quality by which we are wont to distinguish those commercial enterprises only, the prosecution of which is attended with profit; and it is manifest that steam-voyaging across the Atlantic, or across any other great tract of water, may be perfectly accomplishable, and yet eminently unsuccessful.

Antecedently to the establishment of a regular steam communication between Great Britain and New York, considerable discussion took place, and much interest was excited, respecting the probable issue of that measure. At the meetings of the British Scientific Association, held at Bristol and Liverpool, an opinion was broached by Dr. Lardner, to the effect that, in the existing state of the steam-engine, as applied to nautical purposes, a permanent and profitable communication between Great Britain and New York by steam-vessels making the voyage in one trip, was in a high degree improbable; and that, therefore, the schemes then in agitation for the attainment of that object, possessed no great promise of a successful termination. Upon the other side it was contended, that the voyage between Great Britain and New York in one trip could be accomplished perfectly well; from whence it was inferred, that the schemes in agitation for its accomplishment would be successful,—the practicability of accomplishing the voyage being regarded as the measure of commercial success. To this hypothesis it was objected by Dr. Larduer, that the performance of a single steam voyage, or of twenty steam voyages across the Atlantic, in one unbroken line, argued nothing further than the practicability of accomplishing the voyage by steam agency; that it would be preposterous to suppose that a steam-vessel, if only sea-worthy, should be incapable of making her way across the Atlantic; and that several steam-vessels, the *Savannah*, the *Curaçoa*, the *Donna Isabella*, and others, had performed that voyage already; but that the question was not whether an Atlantic voyage was or was not accomplishable by a steamer,—a question already determined by experience in the affirmative,—but, whether a succession of voyages could be maintained with safety, regularity, and profit? without which last element, he contended, the enterprise could not be permanent, or, in other words, could not be successful. In the existing state of steam navigation, he alleged that his fears of the successful issue of the Atlantic schemes then in agitation greatly preponderated over his hopes; and he showed this conclusion to be founded upon the irrefragable basis of figures, which, he submitted, was a somewhat safer foundation than the rhetorical representations of a set of ignorant enthusiasts.

The outcry and vituperation which followed Dr. Lardner's announcement of the unpromising character of the Atlantic enterprise, and the perseverance and success with which his arguments were misrepresented, when found unsusceptible of refutation, have had the effect of enveloping the question in a cloud of mystery, which even subsequent and more sober inquiry has been unable effectually to penetrate. Doctrines have been imputed to Dr. Lardner, which any candidate for Bedlam would have disdained to acknowledge; and the credulity of the populace, in giving ear to such absurdities, has been only equalled by the malignant zeal with which the imputations have been disseminated and persisted in. Instead of replying to what Dr. Lardner *did* say, the projectors of the Atlantic enterprise congratulated themselves upon answering most triumphantly what he *did not* say:—a stratagem characteristic of conscious imbecility, and of that very imperfect solicitude about exactitude, which so generally accompanies the advocacy of a visionary scheme. But truth will ever vindicate the honour of her ministers, and manifest the supremacy of her power. The voice of reason may be drowned in the clamour aroused by conflicting interests, but is sure to triumph when the tumult of excitement has subsided. Enthusiasm may win a battle; but it is only the material interests of mankind that can keep the field: and, though some epidemic delusion may have been instrumental in the establishment of the Atlantic enterprise, it is not to be expected that such an agency should ensure its continued prosecution.

The history of Atlantic voyaging furnishes, indeed, an instructive lesson to future adventurers in the domain of steam enterprise, which they ought not readily to forget. That a swarm of penniless projectors should be ready to urge forward a scheme, by which, whether ruinous or successful, they would be sure to derive some intermediate benefit, is an event so perfectly in accordance with the order of nature, as to be neither astonishing nor infrequent; but, that a co-partnery of British merchants, a class of men distinguished throughout the world for their probity and penetration, should blindly rush into an impracticable enterprise, as if they expected that the laws of nature should bend to their vain hypothetical prepossessions, is an anomaly, to which the only key is to be found in a temporary deprivation of commercial sanity;—an affliction, which the violence of speculative excitement occasionally developes, and which, in the term "mania," has found its distinctive and appropriate denomination.

During the discussion of the question of Atlantic steam voyaging, the steam mania was at its meridian. Expectation disdained all reasonable limits; and the popular faith in the omnipotence of steam agencies degenerated into an undistinguishing reliance upon the promises of all steam projects. With a suicidal infatuation, proper only to so unhappy a condition, the promoters of the Atlantic enterprise denounced as illusory every investigation which did not involve the same conclusion as that they so fondly cherished, and so rashly predicted. The aid of philosophical analysis was rejected, as unsuitable to an inquiry, where passion, not reason, was to be the guiding star; and truths, which were found to be inextinguishable, were either studiously shrouded or wilfully perverted. Amid influences such as these, the misrepresentation which has existed respecting the nature of Dr. Lardner's opinions can scarcely excite our astonishment, however powerfully it may rouse our contempt and indignation: and it may not be a superfluous service to the public, and particularly to those who have interests at stake in the Atlantic scheme, to place the question of Atlantic steam voyaging before them in its true position, divested of that mystification and fallacy in which it has hitherto been so sedulously enveloped. In the execution of this task, it will be proper to recapitulate the doctrines announced by Dr. Lardner seven years ago, as the result of his investigations, and, by comparing them with the results of our experience of Atlantic steam voyaging up to the present time, to ascertain how far those doctrines have been invalidated or confirmed. We would request our readers, and especially those of them who have any direct interest in the inquiry, to dismiss from their minds any long-cherished prejudices which may even yet be disposed to cling to them. The interests of any enterprise are best promoted by a thorough investigation of the difficulties attendant upon its prosecution, whilst a headstrong perseverance in indisputable errors can only add ruin to disaster, and criminality to imprudence.

With a view of obviating all controversy respecting the nature of the doctrines relative to Atlantic voyaging, which Dr. Lardner really promulgated, we shall derive our statements upon that head from those records of his opinions already before the public. We make especial reference to an article contributed by Dr. Lardner to the *Edinburgh Review*, immediately subsequent to the date of the meeting of the British Association at Bristol, and contained in No. 131 of that publication. From this article we shall make such extracts as we deem essential to the elucidation of this branch of the inquiry.

"The imposing mechanical phenomena, so rapidly and unexpectedly developed by the invention and improvement of the locomotive steam-engine, and its application to railways, have for several years so engrossed public attention, that other means of facilitating the operations of commerce, and expediting the social intercourse of distant masses of people, less fascinating, but not less important, have been comparatively overlooked. The subject of water-transport by steam has, from this cause, received less than its due share of attention: a reaction appears, however, to have been recently produced, and we have now a swarm of projectors much more largely supplied with zeal than knowledge, who, not content with advancing in the march of improvement with that calm deliberation and salutary caution so necessary to ensure a permanently profitable issue for any great undertaking, would rush to their ends, without ever informing themselves of the means at their disposal, and proceed, *per saltum*, from a Channel trip to the circumnavigation of the globe.

"Within the last year, considerable public attention has been directed to the question of the practicability and advantage of establishing a line of steam communication between Great Britain and the United States; and various projects have been started, and companies formed, for the construction of vessels for that purpose, several of which are already in a state of some forwardness. At the meeting of the British Scientific Association, held at Bristol last September, one of the topics which engrossed a large share of interest, was the question of the practicability of a steam voyage across the Atlantic, raised in the Mechanical Section. The statement laid before that Section by Dr. Lardner obtained such publicity at the time through the press, that it would be superfluous now to recapitulate its arguments. The conclusions, however, at which he arrived, were briefly these:—That, in the present state of the steam-engine, as applied to nautical purposes, he regarded a permanent and profitable communication between Great Britain and New York, by steam-vessels making the voyage in ONE TRIP, as in a high degree improbable; that, since the length of the voyage exceeds the present limits of steam power, it would be desirable to resolve it into the shortest practicable stages; and that, therefore, the most eligible point of departure would be the most western shores of the British Isles; and the first point of arrival, the most eastern available parts of the western continent; and that, under such circumstances, the length of the trip, though it would come fully up to the present limit, would, nevertheless, not exceed it; and that we might reasonably look for such a degree of improvement in the efficiency of marine engines, as would render such an enterprise permanent and profitable."

To these conclusions of Dr. Lardner's it was objected, that the data upon which his computations were founded had been derived from the performance of steam-vessels antecedently to 1834; that, since that period, considerable improvement had been accomplished in steam machinery, by which greater economy in fuel had been attained; and that it was proper that the question of Atlantic steam voyaging should be viewed in reference to those improvements, and in connexion with the most improved description of steam machinery then existing. To this principle of estimation Dr. Lardner of course assented, and the article in the *Edinburgh Review* was written for the purpose of showing that his deductions were in perfect conformity with the proposed criterion. With the same object, he computed, from the log-books of Government steam-vessels, the exact numerical performance of several of the most efficient steamers then existing. These computations were subsequently verified by Mr. Barlow, and their accuracy has never once been called in question. They are embodied in the following table:—

Name of Vessel.	Hours under Steam.	Fuel consumed in lbs.	lbs. per H. P. per hour.	Rate of Vessel in knots per hour.	Locomotive duty in miles.
African........	3,895	3,834,656	10.9	5.13	1,054
Blazer	1,645	1,693,020	10.3	6.9	1,500
Confiance......	2,279	2,261,196	10.	6.2	1,389
Firefly	2,206	3,110,688	10.7	6.25	1,308
Medea	1,176	2,153,508	8.3	7.8	2,105
Pluto..........	986	954,240	9.7	6.5	1,501
Tartarus.......	914	976,500	10.7	5.5	1,151
Dee...........	1,161	1,933,092	8.3	6.5	1,754
Flamer........	780	1,000,272	10.7	6.	1,256
Dolphin........	5,500	67,200	12.	9¾	1,820
Private Steamer.	2,259	28,225	12.5	7.7	1,380

The voyages of all these steamers had been made since the middle of 1834, and were, therefore, free from the objection brought against Dr. Lardner's reasoning at Bristol. They lead, nevertheless, to the same conclusion as that which he there promulgated, namely, that in the existing state of the art of steam navigation, the Atlantic enterprise could not be carried on with safety, regularity, and profit.

If a steam-vessel of any given power and tonnage be laden with coals to the extent of her capacity, she will possess within herself the power of accomplishing a voyage of a certain determinate length, by the agency of steam alone. Every improvement by which fuel is economised will contribute to extend the distance over which a cargo of coals will carry her; and it is convenient to establish some conventional unit, by which the propulsive efficacy of a given quantity of coals may be approximately measured. Dr. Lardner has proposed that this unit should be the distance over which a ton of coals per horse-power is capable of propelling a vessel; and he has conferred upon it the appellation of the *locomotive duty* of the coal. That vessel then, which possesses the highest locomotive duty, is capable of being propelled by a given quantity of coals per horse-power through the greatest distance, and furnishes the most favourable standard which, in the existing state of the art, can be furnished of the prospects of ocean voyaging. Antecedently to the construction of the *Great Western*, the locomotive duty of the *Medea* is universally admitted to have been greater than that of any other vessel whatever. The performance of the *Medea*, therefore, as being the most favourable to the prospects of the Atlantic enterprise, was taken as the basis of Dr. Lardner's computations.

The acclamation which greeted the performance of the first voyages of the *Sirius* and *Great Western*, betrayed an ignorance of the real question which had to be determined, and was as puerile as it was premature. The practicability of a voyage being accomplished by a steam-vessel across the Atlantic was a point so far from being then in agitation, that it had been long previously set at rest by actual experiment. The only question at issue was, whether the enterprise *would pay;* and it is scarcely to be expected that the success or failure which awaited an undertaking of such magnitude and complication should be determinable with certainty by a reference to the results of one or two voyages. It is difficult to perceive, therefore, from what source the extravagant congratulation which flowed from the first voyages of the *Sirius* and *Great Western* could properly arise. Our readers may, perhaps, derive some illumination upon this point from an article in No. 123 of the *Quarterly Review*,—provided they possess the art of resolving unmeaning rhapsodies into common sense.

"The effect of this achievement is by no means easily to be described or foreseen. Even the Americans, with all their reputation as a self-possessed and considering people, have displayed unwonted raptures and antics on occasion of the first arrival of the *Sirius* and *Great Western* at New York, quite as much so as our Bristol neighbours on their return; and we are not sure that either party is to be blamed for it. We are not sure that the former are far out of their reckoning, when they speak of this as a new epoch in the history of the world. We can enter into the feelings of the myriads who crowded the wharfs at New York, when the English boats were hourly expected; when, finally, after days of almost breathless watching, (which, to fearful spirits, might well have afforded some pretext for disbelieving the new scheme,—some excuse for even casting ridicule on it after all,) at length, on the morning of St. George's day, the doubts, the fears, the scorn, were alike destined to be removed for ever from the mind of every living creature—(even, we dare say,—but let us say it with due deference,—from that of Dr. Lardner himself;) for now appears a long dim train of distant smoke, in a somewhat unaccustomed direction; it rises and lowers presently, like a genius in the Arabian Nights, portending something prodigious;—by and by, the black prow of a huge steam-boat dashes round the point of some green island in that beautiful harbour,

'Against the wind, against the tide,
Steadying with upright keel.'"

That the natives of New York must have been astounded by the entrance of a steam vessel into their beautiful harbour is an assertion it would be unreasonable to dispute. Such genii as steam-boats, are, it is well known, by no means indigenous upon the Hudson, and the appearance of a long train of distant smoke might well be accepted as the presage of something prodigious, if only conceived to portend the advent of the Quarterly's vaporous dissertation. It is reasonable to infer, that the arrival of the English boats at New York must have left even Dr. Lardner without a "doubt or fear" of the practicability of the Atlantic voyage being accomplished by a steamer, especially if it be considered that no "living creature" could even have entertained a "doubt or fear" upon that subject. That the Atlantic enterprise was beneficial appears to have been made manifest to this gentleman's apprehension, because it was shown to be physically accomplishable—a canon by which we might demonstrate the excellence of a speculation which proposed the formation of a tunnel from Dover to Calais, or the construction of a railway from Turnham Green to the Wall of China.

The *Quarterly* proceeds: "Steam, to say nothing about electricity and magnetism, is no respecter of romance; it reduces things to an appalling regularity. The British and American Steam Company, who have just launched at Blackwall a ship 38 feet longer than any in her majesty's navy, with accommodations, as they advertise, for 500 passengers, notify to us moreover, that next year they mean to have boats like this running on each side on the 1st and 16th of every month. This is but one company:—one which has not yet moved, we believe; for we understand the *Sirius* to have been sent out by another, and the *Great Western*, it is well known, belongs to Bristol. Glasgow, too, will no doubt bestir herself, and above all, we must leave room for Liverpool. The sole marvel is, that Liverpool has waited so long, a secret only to be explained by the extent of interest there invested in the American liners. We see that a company has now started at that port who announce immediate operations.

"At New York, again, where the same remark just made of Liverpool applies, even during the short stay of the first steam-boats, a scheme was started of a joint-stock of a million and a half of dollars, in which, by the way, it was stated, the Bristol company, with a liberal view to the interests of that port, would participate to the extent of one-sixth."

It is almost needless to observe that these flowers of promise have been either nipped in the bud, or blasted in the blossom. The Yankees, by the aid of their wonted acuteness, came out of the tumult unscathed; they hazarded, and therefore lost, nothing; they derived their full proportion of the benefit, leaving the complaisant English to sustain all the loss. Of the frantic "go a-head" spirit which animated the speculators of those times, the *Quarterly's* oracular expositions may be accepted as an accredited memorial.

"We were speaking, however, of the first sensation the achievement has produced, and which, we venture to predict, will at some future day be a matter of no little historical curiosity. The New York editors seemed scarcely able to contain themselves. 'Side by side with the old world at last,' says one; 'now then for the coronation,' cry half-a-dozen more; and then the files of European journals unrolled," etc., etc., etc. A few grains of sanity are only wanted to make this flood of eloquence irresistible.

"Some one has predicted that we shall have Covent Garden Market stocked by the other continent. As to the floral department, there may be something in it for aught we know, and indeed in some others too; for, if the liners could bring the *Duke* a present of fresh forest venison from his Western admirers, we certainly get a clear vision here of divers good things to come. We say nothing, however, of Yankee ice dropped at sunrise in dog days upon every door in London, as in Boston—not one word. *Nil admirari*, we repeat as our motto; keep cool, that is, ice or no ice, dog days and all."

As the injunction to keep cool apparently involves the necessity of being in the clouds, we must be content for the present to forego the felicitous alternative.

"It is only 30 years since Fulton ascended the Hudson with his boat. In 1810 there was no such thing in all England, and so late as 1820 there were but thirty-five. The most important improvements have been *very* recently introduced; and without particularizing these, it is sufficient to say that the learned Dr. Dionysius Lardner's miscalculations on this subject of Atlantic navigation have evidently been caused by almost wholly overlooking these same improvements, even so far as some years past are concerned, (and a year in such a progress as this agent is making is a matter not to be overlooked,) or regarding them too much as mere speculations not likely or not yet fully proved to be capable of great practical effects, (as they have already been;) while as relates to what may yet be established, though now it is but experimental, or of what may be discovered, of which nobody now dreams, the calculations in question have apparently left no lee-way for the ingenuity of our successors or even our contemporaries. It was taken for granted that all had been done which could be done, that there were not any 'hidden powers' hereafter to be brought to bear upon steam navigation as well as upon other things, and to supersede steam itself altogether. How grand a mistake this was we need not say; let us beware of its being made again."

We should be sorry to imagine that it was the wish of the *Quarterly* reviewer purposely to distort Dr. Lardner's statements and opinions. The misrepresentations, therefore, of the preceding passage are probably attributable to the enthusiasm of the reviewer's temperament, conjoined with his manifest unacquaintance with the nature of the subject upon which he thinks fit to dogmatise. Our readers are already aware, that Dr. Lardner's computations had reference only to the existing condition of steam navigation. His words are, "That in the *present* state of the steam-engine as applied to nautical purposes, he regarded a permanent and profitable communication between Great Britain and New York, by steam-vessels making the voyage in *one trip*, as in a high degree improbable." We have already seen, that at the time Dr. Lardner's computations were made, the *Medea* was universally admitted to be the most efficient steam-vessel afloat, and that his computations were based upon that vessel's performance. Upon what grounds, then, Dr. Lardner can be charged with having overlooked recent improvements we are totally unable to discover. We are equally at a loss to understand upon what principle he could have regulated his calculations by the anticipation of discoveries of which nobody now dreams, or by a reference to appliances which are now but experimental; or how the question of the practicability and advantage of accomplishing Atlantic steam navigation in the year 1837 could be determinable by the contemplation of the possible improvements which another year or century might develope. Had Atlantic steam voyaging, instead of being as it is, a miserable failure, been eminently satisfactory and successful, that circumstance could not have invalidated a single line of Dr. Lardner's statements, provided only that the success alluded to had been attained by the realization of novel improvement in steam machinery, and not by the simple exertion of those powers of steam navigation already existent.

Of all the steam-vessels which have attempted Atlantic voyaging, the *Great Western* has been out of all comparison the most prosperous and efficient. Her performance has exhibited a considerable improvement upon that of the *Medea*, a circumstance partly due to the greater magnitude of the ship and the superior power of the engines, but chiefly consequent upon the realization of improvement in marine steam machinery. It is by the superiority of the *Great Western's* performance that the character of the Atlantic enterprise has been chiefly sustained, and the excellence of that vessel certainly reflects the highest credit upon the eminent firm by which her machinery was constructed. How far the superior performance of the *Great Western* may have arisen from a salutary circumspection, which Dr. Lardner's admonitions may have in some degree inspired, it would be superfluous now to conjecture; but what, let us ask, would have been the immediate fate of the Atlantic enterprise, had those novelties to which the *Great Western* owes her superiority been, as they might have been, unsuccessful? A degree of economy already attained in any one vessel is attainable with certainty in any other, and it was right to measure the probable economy of the *Great Western* by that of the *Medea*, the most economical vessel at the time extant. But that a given alteration in steam machinery, which has for its object the attainment of greater economy than has yet been realized, will certainly be productive of the desired success, is an allegation both precipitate and indecorous. The most specious schemes often fail when reduced to practice, and upon no evidence short of that derived from repeated experience can our confidence in new projects in steam machinery be commanded. That the novelties introduced into the *Great Western* have proved themselves to be real and valuable improvements we willingly allow: but who could tell, *previously to trial*, that such would be their character? Can the fortunate issue of the *Great Western's* experiments, then, furnish any extenuation of that spirit of reckless adventure that would hang the prospects of a gigantic enterprise upon a contingency so uncertain? The precipitation which would rush into a scheme of consummate magnitude and peril, where the chances of success rested upon no basis that experience could furnish or even analogy justify, can derive but a slender apology from the happy discovery of new modes of operation, by which the dangers proper to the undertaking may have been in some measure averted, and the anguish of the disasters in some degree assuaged.

Whatever success then may have attended the voyaging of the *Great Western*, or whatever success might have attended her performances, had the consumption of fuel turned out to be one-tenth part of what it really is, can be no justification of that injudicious temerity that is willing to rest all upon a foundation so hypothetical as the attainment of improvements not yet found out. A policy such as that pursued by the originators of the Atlantic enterprise argues an independence of every approved principle of commercial procedure neither to be imitated nor applauded: and certainly we have no ambition to trespass upon the prerogative of the *Quarterly* reviewer, in panegyrising aberrations so far transcending the trammels of precedent, and so superior to the prejudices of common sense.

In order to form some approximate estimate of the difficulties attending the navigation of the Atlantic, as compared with the difficulties of those less extended voyages to which steam navigation has been for the most part restricted, it is necessary to consider the circumstances of wind and water attendant upon each species of navigation. Dr. Lardner has explained at some length the physical phenomena by which the Atlantic is distinguished, so far as those phenomena would affect the establishment of a safe and commodious highway across that ocean.

"The general atmospheric currents which prevail in directions near and parallel to the equator from east to west, called the *trade winds*, would have a tendency to produce a derangement in the atmospheric equilibrium, if not redressed by a contrary effect elsewhere. It is well known that these remarkable winds are produced by the influence of the solar heat upon the atmospheric belt included between the tropics, combined with the diurnal motion of the earth from west to east. The heated air pressed upwards by its buoyancy is replaced by currents from either hemisphere, which carrying with them a less diurnal motion than that proper to the tropics, a relative atmospheric motion is produced contrary to that of the earth's rotation; hence, a nearly permanent wind is produced on each side of the line from east to west. As these currents approach the line, they gradually acquire the motion of the surface, which combined with their mutually counteracting effect, produces those calms which prevail about the line, and which are only interrupted by the hurricanes, whirlwinds, and other violent atmospheric commotions which are produced where the contrary tropical currents conflict, before their force is sufficiently moderated.

"The stagnant atmosphere thus collected at the line, ascending by the effect of solar heat, returns from the upper regions towards the Poles, and coming upon the surface in either hemisphere, brings with it the diurnal motion of the equator, which being greater than that of the higher latitudes, prevailing winds are produced from the west. The agency of these causes is manifested in the westerly winds which prevail almost uniformly throughout the year in the Atlantic, between the shores of Europe and those of North America.

"There are other physical causes which mingle their effects with those to which we have just adverted. The extensive regions of North America, covered with immense fresh water lakes and primeval forests, supply a current of cold air rushing into the warm strata over the tract of ocean between the Azores and the American coast. This current from the north-west, consequently, modifies the reaction of the trades just explained. The result is, winds blowing generally in the westerly direction, but varying between north-west and south-west, and sweeping across the face of the Atlantic throughout nearly the whole year.

"Atmospheric difficulties are not the only ones which the navigator has to encounter who crosses this extensive tract of water. The well-known Gulf stream is a great ocean current issuing from the channel which separates Florida from the Bahama banks, taking first a direction a little to the east of north, and becoming more and more easterly till it approaches within a short distance of the tail of the great bank of Newfoundland. The width of this current, at first one degree, gradually increases until it exceeds two degrees. Independently of the difficulty presented by the stream itself, the zone of the ocean marked out by it is characterized by weather so extremely unfavourable to navigation, that it is cautiously avoided by all outward bound vessels. They invariably take a course, either so far north as to be clear of its influence until they approach the western shores, where, by taking a southerly direction, they convert the westerly winds into favourable gales; or, on the other hand, proceed at first southward, till they get beyond the lower limits of the gulf stream, and taking advantage of the trades, make the western coast. This latter, however, is a route never adopted by the best class of the New York packets, except they are reduced to a disabled state.

"The westerly winds, which we have described as prevalent across the Atlantic, are accompanied by a heavy sea, which is subject to scarcely any subsidence or intermission. In land-locked seas, such as the Mediterranean, and the channels which intersect contiguous islands, the effect of the wind in raising the waters is rapid, and produces a short and chopping sea highly unfavourable to steamers; but these effects very speedily subside, and in the Mediterranean especially they produce but a slight influence upon the average rate of vessels, when that average is computed upon long continued performances. On the other hand, the long swell of the Atlantic is not so unfavourable during its operation, but its effects are incessant; and considerably more disadvantage to a steamer will be produced by its continuance, than any which the occasional roughness of the more contracted seas to which we have referred could give rise to."

The detriment arising from these peculiarities of Atlantic voyaging is materially aggravated, when a very large vessel is subjected to their influence. The long swell of the open ocean has the same relation to a very large steamer in impairing her powers of propulsion, that the short chopping seas of land-locked waters have to a steamer of smaller dimensions. The straining to which a steam-vessel of the largest class is subjected in the contention of the gigantic waves of the Atlantic, is infinitely greater than any straining to which a smaller steamer in the same situation could ever be exposed. The force of masses of water roused into violent commotion by the energy of an unbroken hurricane, and hurled with accelerating momentum over a tumultuous confluence of waters 3,000 miles in compass, is inconceivable, and is such as an immense vessel, forcibly impelled by opposing steam power, can neither successfully elude nor safely encounter. The frequent appearance of icebergs in the latitudes which North Atlantic steamers must necessarily frequent is another source of great and peculiar danger. Sailing ships have comparatively little to fear from these masses of floating rock, as an iceberg will be driven before the wind nearly in the direction a sailing vessel would probably require to assume; whereas, in the case of a steam-vessel, it might be driven by the force of the wind in direct opposition to the line of the vessel's progress. If the iceberg and the steamer were both of large dimensions, and the steam power acting at the time with its full energy, the force of the collision would be such as no structure could possibly withstand. The calamity of fire, to which steam-vessels are exceedingly subject, is another source of peculiarly appalling danger in the case of ocean-voyaging. In the navigation of the Channel and more contracted seas, a steam-vessel, if on fire, may generally be run on shore or into port, should such an expedient be found necessary. But in the middle of the open ocean there is no such alternative, and but a feeble hope of safety. No practicable supply of boats could furnish means of escape to several hundred persons; and though the sea may be smooth and the weather propitious, the most miserable of all deaths may await the majority of the unfortunate passengers. Whether the loss of the *President* is attributable to fire, to collision, or, as some have alleged, to the insufficient strength of the vessel, and the overwhelming force of Atlantic storms, it would be futile now to conjecture; but the lesson afforded by that dreadful calamity conjoined with the great injury which the *British Queen* and other vessels have sustained, ought to be sufficient to convince us of the formidable difficulties which lie in the way of steam voyaging across the Atlantic in one unbroken line, and of the deficient security of those leviathan vessels that are indispensable for that object. Such vessels present a greater surface to be acted upon by the violence of Atlantic storms, and are far more susceptible of injury than vessels of more manageable and less extended dimensions.

There are numerous other considerations which ought to be kept in view in the formation of any estimate of the difficulties attendant upon the establishment of a steam communication between Great Britain and New York in one continuous line, but it would far transcend the limits of this article to enter upon them with that minuteness of detail which their importance merits. We shall only offer, therefore, a few passing remarks upon this branch of the subject; rather with a view of showing the impracticability of doing it justice than of exemplifying its magnitude and moment.

The flues of all boilers in which coal is burnt become speedily covered in the interior with a coating of soot which greatly impairs the conducting power of the metal of which they are composed. The consequence of this defect is, that the hot air proceeding from the fire to the chimney gives out its heat very imperfectly to the water in the boiler. In short voyages the flues can be frequently scraped and swept, and the detriment arising from this source is very inconsiderable; but in long voyages a great accumulation of soot takes place, and the smoke being unable to give out its heat to the water, escapes from the chimney at a high temperature, and correspondingly diminishes the useful effect of the fuel. The imperfect conduction of the flues is further increased by the preternatural deposition of scales in the interior of the boilers arising from the continued action of the fire upon the super-salted water of the boiler for weeks in succession, and without any opportunity having been afforded intermediately for the removal of this deposit. The stuffing-boxes and various packings about the engine are liable to become leaky by the uninterrupted action of the moving parts of the machinery through the duration of an Atlantic voyage; and although some of the parts of the machinery may be readjusted by being screwed up afresh, other parts, such as the bucket of the air-pump, cannot be readjusted whilst the engine is in motion. The disparity in the draught of water of a vessel when laden with fuel sufficient for one unbroken Atlantic voyage, and when, as towards the end of the trip, the fuel is nearly expended, is another source of serious diminution in the efficiency of the impelling power. At first the paddles are immerged so deeply in the water that the proper speed of the engines cannot be obtained; whilst during the latter part of the voyage the deficiency of the dip of the paddles induces the engines to travel with an unwonted velocity, occasioning an undue expenditure of steam, without communicating a corresponding impulsive energy to the ship. Add to this, that in long voyages, especially if they are at the same time boisterous, the engineers and firemen get soon worn out by anxiety and fatigue, and are neither able nor disposed to give such attention to the feeding of the fires and adjustment of the engine as are indispensable to the maintenance of their full efficiency.

Such are some of the objections brought by Dr. Lardner against the navigation of the Atlantic in one unbroken line. Some of them may, we admit, appear a little over-rated, and have been somewhat lessened in magnitude since the time they were first urged, yet upon the whole they remain wonderfully undisturbed by the gigantic efforts of subsequent years, and up to the present moment experience sufficiently proves that they are insuperable. They all resolve themselves into one grand difficulty—*enormous expense;* and every enterprise which has appealed to experiment against Dr. Lardner's decision has obtained a verdict which not only confirms but has greatly outgone all that he predicted as to the fatal effects of such rash speculation. This will, perhaps, be best made manifest by recapitulating the names of the several vessels which have attempted to maintain a direct steam intercourse between Great Britain and New York, or were prepared for that purpose, noting, at the same time, the present distribution of those vessels.

SIRIUS	*Withdrawn.*
ROYAL WILLIAM . . .	*Withdrawn.*
LIVERPOOL . . .	*Sold.*
ORIENTAL	*Sold.*
PRESIDENT . . .	*Lost.*
BRITISH QUEEN . . .	*Sold.*
GREAT WESTERN . . .	*Sold.*
GREAT BRITAIN . . .	*Sold.*

The *Great Western* is still on the line, but has, we understand, lost much money, although she has been a wonderfully fortunate and excellently managed vessel. She does not, however, now make the passage *direct*, but diverges to Madeira, and occupies twenty days in getting to New York. The *Great Britain* is not yet finished, and we have serious doubts whether she ever will be. The Halifax line partly carries out Dr. Lardner's recommendation, and has thriven better than the other; but even it is a losing game, though very ably managed, and with the present allowance from Government cannot, we fear, be sustained. To crown all, there is the West India Mail Company, which, with an allowance of £240,000 a-year from Government, has nevertheless lost in the course of a few months an immense fortune. Without having yet seen through one winter, this company has already lost two of its vessels; two more are reputed to have the dry rot, and other two are suspected. Two of the vessels, also, have not yet been finished, and whether they will be finished before the company is broken up appears to us very problematical. We are truly grieved for those who have property embarked in this mismanaged and disastrous undertaking. If it be allowed to go on many months longer, every penny ever paid into it will be lost, and we think those parties who are most deeply interested should insist upon bringing the affair to a close without further delay.

Must Atlantic steam voyaging, then, cease? We do not think that it must necessarily do so; for under suitable conditions, we think it capable of being prosecuted with safety, regularity, and profit, but not in one direct line. We shall proceed to explain how we conceive this might be accomplished; though, as the plan is a feasible and good one, it must not be imagined we expect it will ever be adopted. We throw it out, however, for the benefit of the parties implicated, and if they choose to be as stiff-necked as we have always found them, they are welcome so to continue.

We would unite, then, the Halifax and West India Mail Companies, and agree to perform both mail services for £250,000 a-year, on the condition that the Government took the West India Mail vessels at a fair valuation. Fayal we would make the pivot of operations. The Halifax or New York vessel would call there and deliver the West India Mails; and we would have a line of steamers between Fayal and St. Thomas, or some of those islands, of the same size as the steamer *Tagus*, described in another part of this number. The mails we would distribute among the several West India islands by means of iron steamers, not exceeding 250 tons burden and 60 or 70 horses power.

The objections to this plan are that Fayal is not a British port, and that a considerable expenditure of money would be required to build the wharfs and storehouses requisite to make it the entrepôt of so important a commerce. But we think a satisfactory arrangement could be come to with the Portuguese government upon these points; and the offer indeed has already been made to an English company to give up to it all the port dues for a certain number of years, on the condition of rendering Orta a safe and commodious harbour; which could, we understand, be done at a moderate expense.

The advantages of the plan are, that it would give an entirely new character to Atlantic steam voyaging and make it profitable and satisfactory. The North American steamers would reach Fayal with a trifling divergence, and might leave port with little more than half the quantity of coals, leaving, of course, the remaining room for cargo. The whole distance between Fayal and England, on the West India line, would evidently be saved, and the necessity of leviathan vessels altogether superseded. The Government, by the arrangement, would save £50,000 or £60,000 a-year, besides having the work done with greater regularity and despatch; and the West India Mail shareholders would get back the greater part of their money or transfer for their interest in an enterprise on the brink of ruin, into one which could not fail under good management to be highly profitable and satisfactory. Without good management, however, the enterprise manifestly would not answer at all, and it is of the last importance that an undertaking of such magnitude and difficulty should be intrusted only to those who have already given some proof of their capacity. Mr. George Burns of Glasgow, Mr. McIver of Liverpool, and Mr. Attwood of the General Steam Navigation Company, would, we are sure, do the enterprise every justice if they would conjointly undertake to conduct it. If novices were let into the management, the scheme would be spoiled irretrievably.

It may be doubted whether the Government would accede to such an arrangement, including, as it does, the purchase of all of the West India Mail Company's ships: we think, however, it would, and that for many reasons. The Government must, of course, be heartily tired of the West India Mail concern, and would, we suspect, be glad to get rid of it at almost any price. It is much to have regular arrivals, instead of having the whole mercantile community up in arms; and it is much, too, to save £50,000 or £60,000 a-year, and at the same time have the work better done. The West India Mail vessels would serve the Government very well as steam-frigates, to which purpose they are far better adapted than to the transport of merchandize; and although some of them are unsound, the greater number are well built vessels, and those to which any defect attaches would of course be thoroughly scrutinized and adjusted before being offered for sale. The Government would not have to purchase the vessels for more than they were worth, whatever that might be, and the Company on the other hand ought not to receive less.

Should these reasons appear inconclusive, they may perhaps derive additional weight from the reflection, that the Government must at the present moment be anxious to mitigate the sufferings of our artizans, particularly in the out-ports, by affording them such employment as may perhaps avert some dreadful convulsion from the wide-spread and insufferable privation and distress. The adoption of the arrangement we propose, would make it necessary to build a line of vessels such as the *Tagus*, besides others of a smaller size; and we are sure a few such pieces of work would be highly acceptable in Greenock at the present moment, and go far to remove the Government out of the dilemma in which it obviously stands in reference to the distress spread over that industrious place.

Such, then, is our recipe for making Atlantic steam-voyaging accomplishable with safety, regularity, and profit. Amid the apathy of some and the perversity of others, it will of course remain untried; but we are thoroughly convinced of its virtue as well as of its ultimate adoption; and we merely record it here in order to bequeath it to a wiser and less untractable generation.

Art. III.—THE COLLEGE FOR CIVIL ENGINEERS.

This establishment has always had our best wishes for its success; and at one time inspired us with considerable hope that it would approve itself a valuable and robust institution. We have always been of opinion, indeed, that a proficiency in the arts of Engineering and Architecture might be attained by a much less tedious and expensive process than through the mechanical drudgery of an office; and we were disposed to look favourably upon the expedients of this establishment, not only as facilitating the progress of juvenile aspirants, and bringing together, for their use, the scattered knowledge which was previously inaccessible, but as promising to shed over the different branches of the constructive arts a spirit of enterprise and emulation highly conducive to their further development. In these expectations, however, we have been wholly disappointed; and this new school, instead of shining out as a light and ornament to the nation, has dwindled into an object of universal derision: Engineer, Architect, and Artizan, all unite in laughing it to scorn; and, while failing to produce the good originally contemplated, it binds the curse of its bad reputation on those unfortunate youths who may be convicted of being of the number of its disciples. Few such undertakings hae been commenced at a more auspicious juncture, or have proposed to themselves a more reasonable object; fewer still have been equally fortunate in conciliating the aid of able and illustrious supporters; and none has ever more effectually turned these combined advantages into nothingness, by the perversity and sordidness of its administration, or more effectually cut itself off from the high destiny which naturally waited upon so excellent a design.

Among the more influential portion of our established engineers, this College has been viewed from the first with but little favour: it has been denounced as a superfluous and visionary undertaking; and we honestly believe that every false step it takes is still looked upon by many with secret exultation. This enmity is, perhaps, all natural enough on the part of men whose monopoly this institution was intended to uproot; but, however virulent it may be, it is not calculated, we think, to be productive of any very serious injury, so long as the College is true to its own interests. Indeed, the opposition of any interested sect to any such establishment of real value, can only force it into a more commanding position, by proclaiming the fears of established practitioners for the continuance of their supremacy; but such an opposition will be speedily fatal, if the institution be inefficient and unstable, and possess no hold upon the public confidence. This last is, we fear, very much the condition of the College for Civil Engineers; and unless a thorough reformation be carried out, so as to extirpate the abuses and frivolities we shall specify, we can only look for its speedy dissolution. As sincere friends to the undertaking, it is needless to say that we should like to see it set upon a true footing: yet our hopes are very slender that this will ever be done. We have been too long familiar with the pride and perversity of Directories to expect our friendly expostulations will meet with any favourable attention on the trivial ground of their judiciousness. As the exponent, however, of the judgment of a wide circle of practical and unprejudiced spectators, we do feel that they possess a claim to consideration which ought not to be overlooked; and whatever reception they may meet with from those whose policy they may collaterally condemn, we trust that they will be weighed deliberately by those higher personages who lend the lustre of their names to this Institution, and who can have no interest in maintaining the predominating indocility.

Previous to the formation of this establishment, the want of proper facilities for acquiring a theoretical conjoined with a practical knowledge of Civil Engineering, had been severely felt. In our colleges, it is true, a theoretical knowledge of Mechanics, Hydraulics, and the kindred sciences, was sufficiently attainable; and the practical part of the arts of construction might certainly be learned by the usual routine; but the intermediate and most important step of all was wanting—the application of science to the immediate purposes of the engineer. Add to this, that while the field of engineering had been wonderfully extended in the course of a few years, the means of producing competent labourers in it had not increased in the same ratio; and works, involving a large outlay of capital, were necessarily intrusted to persons unprepared by any previous training, for the successful exercise of their functions, and, for the most part, without the least pretensions to scientific proficiency. Under circumstances such as these, it was manifest that young men of good general education, and who had received a proper training in both theory and practice, would necessarily command a precedence; and it was to provide this proper training that the College for Civil Engineers was established.

To all this there are only two exceptions which appear to us of any weight. First, it was not certain that the demand for engineers, though for the time great, would continue—and, indeed, it has ceased already, so that there is now a redundance of engineers in the market, who have had the advantage of experience in the conduct of important works—and, second, it appeared very uncertain whether the engineers produced in the College hotbeds would be good for anything, when transplanted into the arid soil, and subjected to the atmospheric vicissitudes of actual practice. This last objection is one, we fear, of considerable weight: the practical proficients of the College are, we fear, mere novices in the eyes of the world; and we have serious doubts whether the whole College curriculum is not calculated to make young men of imperfect judgment and no experience very confident, very adventurous, and *not* very successful. The vice, however, if it has any existence, is not one which attaches, we conceive, to the project necessarily, but is accidental only to the mode of instruction at present pursued.

The first time that the College for Civil Engineers came under our notice was in a newspaper notice, in July, 1839. At that time Colonel Jackson was the resident director, and, indeed, the whole soul of the enterprise; and although his views were, in our opinion, sometimes a little impracticable, they were, on the whole, full of sagacity and wisdom. To Colonel Jackson, we conceive, is chiefly due every thing valuable in the constitution of this establishment. He was manifestly a man of talent, and a gentleman; and, by his retirement, the College, we conceive, sustained a loss it has never been able to repair. Had Colonel Jackson remained with the College, he would have secured it from all jobbing, favouritism, and wide-spread discontent, and have repressed any improper interference with the professors. But the enemies of good government were too strong for him; and, finding himself unable to continue in his post with credit, he resigned.

Colonel Jackson was succeeded by Major Hutchinson; a species of amateur mechanic, and a man altogether unfit for the situation to which he was appointed. Up to this time the College had not been opened; but many of the professors had been appointed, and their salaries settled. A great influx of students was of course expected, but only forty presented themselves; and the council, thereupon, resolved to take 30 per cent. off the salaries it had agreed to give to the several professors; to be paid up, however, when the Institution became more prosperous. This beggarly proceeding roused, we suppose, the attention of the President, the Duke of Buccleuch, who very properly interposed; and the proposed reduction was not carried into effect. In the mean time, the period fixed on for opening the College approached; and the rapture of Major Hutchinson was not inconsiderable, at the anticipated magnificence of the pageant. Writing officially to a person on College business, he says, "His Grace will be present at the opening of the College; and I trust that many others will be there, *and ladies too*, so that some eclat will be given to our proceedings"!

In May, 1840, the College opened at Gordon House, Kentish Town, when a number of very fine young men presented themselves to be wedded for life to a precarious and deceitful profession. The premises were very imperfectly prepared for the reception of the students; all was hurry and confusion; and a number of school-rooms had to be built or altered, before the work of the College could be properly begun. These premises were only occupied for a short time. A fever broke out among the students; and on the 13th of August, in the same year, the College reopened at Putney, where the same cost of erecting or adapting buildings, and the same scenes of confusion, were again enacted. During all this time some of the professors could not obtain the necessary apparatus for illustrating their lectures. The resident director, moreover, was perpetually interfering with the courses of study laid down by the several professors, and, in particular, was resolved that certain inventions of his own should be brought under the more favourable notice of the students. The effects of this system began speedily to show themselves: one professor had ceased to be connected with the College at Kentish Town; another left at Putney; and a third was now superseded. At the same time, the medical officer of the establishment was suspended, and his house attacked, for the recovery of some beds or pillows which had been there deposited. The secretary, as generalissimo of the council's forces, headed the assault; and was already retreating with his prize, when he was fallen upon and defeated by the indignant doctor, who had cast off his allegiance to the council, and was resolved that no one should ransack his fortifications with impunity. The account of this contest of course went the round of the papers; and its effect was, to make the College and its officers a subject of laughter from one end of the kingdom to the other. People wondered, moreover, what kind of discipline could be maintained in an establishment where its leading functionaries set the students so admirable an example.

Every day brought symptoms of further disorganization. The resident director was perpetually intermeddling in things which pertained not at all to his department; and there were perpetual changes introduced into every thing, without any improvement. No one could be sure that what was ordained to-day would not be abrogated to-morrow; and all was uncertainty, confusion, and discontent. The students at last rose in open rebellion, broke up every article of furniture in the College, and defied the resident director to do his worst. The council had to make terms with the insurgents; and Major Hutchinson soon afterwards ceased to have any further connexion with the College.

On the 18th of November, 1841, the council called the students together, to hear an address it had prepared touching the late display of insubordination. This address, which is now lying before us, is very long, very argumentative, and very weak: it is almost unique, as a sample of College eloquence: and even we, who make no pretensions to academic accomplishments, would be ashamed to have been implicated in so vulgarian a production. The duty of reading this oration devolved, it appears, upon the Duke of Buccleuch; and we are sure he must have been heartily sick of the whole affair. Who the writer of it was, we are of course unable to say; though, if we were to hazard a conjecture, we should be inclined to lay the blame upon Mr. J., &c. Curtis, the versatile and obsequious secretary. Of the quality of this document, our readers may perhaps form the safest judgment from the extracts we shall lay before them.

> "Before proceeding further, we must in the strongest manner express our disapprobation of the course pursued by a certain number of students, in combining together *to address the council by a joint letter*. It will be obvious to any one who is at all acquainted with the management of institutions like ours, that, if such a course can be adopted without reprobation, no discipline or subordination could be maintained: and although, therefore, under the very peculiar circumstances, we have thought it right, in this single instance, to receive and consider that letter, and to converse with the writers of it, we must distinctly warn you, that if such a course be again adopted, those who are found to be engaged in any such combined or concerted movement will be immediately *dismissed*."

All this, we fear, must have appeared to the students as a mere idle threat. It is manifestly impossible to *dismiss* a whole college; and what justice can there be in holding one act of insubordination to be excusable, on account of the "peculiar circumstances" in which it originated, and at the same time denouncing as inexpiable any such future act, though under "peculiar circumstances" perhaps far more grievous? The crime of addressing the council by a joint letter, is one which we cannot bring ourselves to look upon as very heinous; and, indeed, we are at a loss to imagine in what other way the students could have sought an adequate remedy for the evils which oppressed them. The letter ought, indeed, to have been transmitted through the resident director; but the students, perhaps, had serious doubts whether, in that case, it would have ever reached the council at all; and it must have been manifestly a disagreeable thing to have put into the hands of the resident director a letter occupied chiefly with complaints of his own misgovernment. In short, the complaints of the students may have been very just, although the proper etiquette was broken through, in the mode of forwarding their letter; and any informality in this respect is, we think, a poor source of objection, when the purpose was to obtain a remedy for a crying evil.

The violence into which the students were betrayed, we must of course condemn; yet most of the fault lies, we conceive, with the council, in permitting such an accumulation of disaffection as could only find adequate vent in a dreadful explosion. All *reasonable* discontent will, if not abated by proper concessions, accumulate, and gather strength, till it works its own reparation. And deplorable as the victory may be, which is gained over order as well as over guilt, the blame must rest heaviest upon those who first provoked what may perhaps turn out to be a violent and unjustifiable retribution. The discontent which misgovernment generates is fraught, therefore, with a double evil. In the first place, it corrodes and acerbates almost all that is wise and valuable in a society; and, secondly, secures the ultimate subversion of all discipline and authority: it first heightens tyranny until it makes it intolerable, and then oversets it altogether by a necessary but calamitous convulsion.—We are wandering far, however, from the address: the following savours considerably, we think, of the mock heroic:—

> "We are sorry, also, to be obliged to condemn, in the strongest manner, the conduct of some of the writers of that letter, who, on the very evening on which they had been before the council, and had been told that whilst their complaints would be fully considered, the authority of the resident director must be maintained, evinced the most determined opposition to his regulations, in remaining out of the College beyond the prescribed hour. We trust that the parties concerned will at once feel the impropriety of their conduct; in respect of which it could not have been deemed a harsh or undeserved exercise of authority, to *dismiss* them at once; but, in consequence of the recommendation of the resident director, the council are willing to overlook all that has passed, in the hope that the students will appreciate the forbearance, and avoid all such conduct in future."

This gentleman speaks as if he were addressing the inmates of a nursery instead of an assemblage of clever and full-fledged adolescents. It was, no doubt, very wrong for some of the students to remain out late at night; but youths will do such things sometimes; and, although not to be tolerated as a practice, may surely be pardonable as a transgression. We do not like to hear of *dismissing* students; it sounds as if they were ranked in the same category with household servants.—But, enough of this gentleman's blundering dulness: we surrender him and his oration to the Putney students, who, we rather suspect, are not the sucklings he supposes.

From the hasty sketch we have given of the history of this establishment, most of our readers will, we believe, concur with us in thinking that its affairs have been greatly mismanaged. The chief faults under this head have been, first, the supercession of a good, and instalment of a bad, resident director; and, second, a perpetual interference with the professors, on the part of the council, such as no professor of talent will ever endure. There have been, moreover, innumerable jealousies, intrigues, and heartburnings at the council board. The first directors were to have remained in office for five years; but it was found necessary to bring in monied men to aid the undertaking; and these, as soon as they had made their footing good, turned out most of the previous directors, who, as it happened, however, were for the most part, we think, a good riddance. The office of resident director is, we conceive, a superfluity, and has been judiciously abolished; and the Principal is now, as he should have always been, at the head of the establishment. This is, we think, a great improvement, adding to the efficiency of the College, at the same time that it diminishes the expense; and it should, we submit, be followed up by abolishing the office of secretary, which is not only a superfluous office, but a pernicious one. Its tendency is to assimilate the management of the College to that of a joint-stock company,—to foster a dangerous interference with the details of the several professorships, and to reduce the professors to pretty much the same level, in the eyes of the council, which the captain of a steam-boat, or the guard of a railway-train, occupies in the estimation of a joint-stock company. The existence, indeed, of a secretary at all, is a perpetual temptation to the council to be issuing injudicious orders, and interfering in details with which, properly, it has nothing to do: and if the council does not thus place itself between the professor and the student, it assumes at least a position so far above both, that, relatively, the positions of the two are very nearly approximated. The office of professor thus loses its proper force and authority, and the council and secretary are uselessly glorified at the expense of the reputation and the real efficiency of the establishment. An extract from some of the official papers issued by the secretary, in the name of the council, will, perhaps, best explain the species of degradation to which we refer; and we may take the following from the *code of discipline* now lying before us:—

> "Gambling, swearing, smoking, and any other improper habit, or making use of any profane and improper language, is most strictly prohibited.
>
> "All intercourse with the servants, or interruption in their duties, is strictly prohibited.
>
> "The association of *students* with improper characters in the neighbourhood, will, if persisted in after warning, render the offender liable to expulsion.
>
> "The *professors* are required by the council to make to the resident director monthly reports of the classes.
>
> "Whenever a professor may be displeased with the conduct of any student during the time of study, he will report the same to the resident director.
>
> "The officers of the College are required to appear in the uniforms when on duty, and the professors in their gowns. &c. &c.
>
> "By order of the council,
>
> "J. E. B. CURTIS, Secretary."

Classifications such as this are certainly calculated to degrade the professors in the eyes of the students, by needlessly obtruding the subordinate rank the professors are made to occupy, and proclaiming that the council is the body in which all power is concentrated. It would be far better, we think, that the council should in such matters communicate with the Principal alone; and that he, as head of the College, should, after having been duly instructed and authorized, issue any orders which may be required to be made public.

We have already intimated our sense of the importance of a scientific education to the Civil Engineer; and, in particular, of that description of reduced or applied science, which it is the object of this establishment to furnish. Most engineers, indeed, are in possession of such rough rules as enable them to approximate to correct results: but cases are perpetually arising in practice, to which old rules will not apply; and, even in the more familiar cases, those who are so far conversant with principles as to see the reason of the rule, as well as the rule itself, must, we conceive, have more confidence in their own judgments, and be, *pro tanto*, much safer advisers than those who proceed on a principle altogether empirical. There are many problems in engineering, moreover, to which science has not yet been applied; and, although a rude solution to them has been obtained mechanically, it would be highly desirable that they should be brought under the dominion of calculation. For these and other reasons which might be mentioned, we think any scheme of engineering instruction radically vicious, in which science does not claim a distinguished part: and this Institution offers eminent advantages in this particular. This is very happily shown forth in the original prospectus, from which the following is extracted:—

> "It is manifest that those men who are to direct the practical application of those arts and sciences on which the efficiency of our machinery depends, should be thoroughly ground in natural philosophy in all its branches, and in the collateral knowledge of those subjects which are necessary adjuncts. They are in a great measure responsible for the profits on our internal industry—on the average of which depends agricultural returns; and also, by reaction, an increased demand for labour. To the Civil Engineer the public looks for safety and stability in the structure of railways—the capacity and strength of our canals—the clearing and improving of our navigable rivers—the construction of our docks—and the rendering our harbours secure from the effects of winds and waves. On him depends the clearing of mines of water, and their necessary ventilation—to him his country looks for simplifying the means, rendering safe, and accelerating the transit of the world; and, lastly, on his ability we rely for the correct and economical expenditure of much of the available wealth of the realm, which, when thus used, like the seeds of the earth, increases, and facilitates further production.
>
> "Hence the national importance of the profession of the Civil Engineer is obvious: and this being admitted, it is manifest that an exclusive system of education should be sedulously pursued by those on whom such great responsibilities are imposed. The object of this Institution is, to afford the means of pursuing such an education, and, by combining theory and practice, to keep pace with the continued and rapid advances in the boundless fields of practical invention and scientific discovery. The Institution, moreover, by bringing the minds of young and inquiring students into apposition, induces emulation, causes new ideas to be elicited, and inspires the confidence so essential to future success—advantages only to be procured by a public education."

This appears to us, upon the whole, just and satisfactory. In particular we are disposed to attach much importance to the emulation excited by bringing together a number of active and aspiring minds; and we do conceive that the intellect will be brightened and the ingenuity inflamed by their sanguine contests for distinction; that the light and heat elicited by this intellectual percussion may quicken into life the torpid fibres of genius, and expand the embryo blossoms of promise into the splendour of an enduring fame. We think, too, that the scientific proficiency of the students of this College will greatly exceed that of most other young engineers, and cannot fail to be of much advantage to them in the world; yet it must never be lost sight of, that although science is an important part of an engineer's education, it is not the *most* important part; and the wise student will be on his guard against its seductions, and especially resist the belief that it is all-sufficing. Young men are extremely liable to plume themselves far too much upon their scientific attainments: because they may be more expert algebraists than their seniors, they are apt to imagine themselves abler engineers; and their scientific education, instead of adding to their professional skill, may only lead them to neglect those more serious labours on which a true reputation can alone be founded, and make them sit down content with the frivolous praise of mathematical proficiency.

We feel, therefore, that the value of science to the engineer may be greatly overrated, and in any course of instruction where science necessarily predominates, this exaggeration of its value is very likely to take place. Instead of being looked upon as the *means* of instruction, it is in danger of being taken for the *end*, and of assuming the lead of other exercises to which it should be held subordinate. The natural tendency, too, of such studies, and perhaps their common effect, is to discourage enterprise and originality, to nourish a plentiful growth of pedantry and conceit, and to chasten into dull sobriety those flights of the fancy in which all invention has its origin. Mathematics in particular superinduces a habit of mind naturally fatal to every germ of imagination implanted by nature, and must, therefore, go far to discourage the higher enterprises of inventive genius. In addition to this, the store of information which a scientific education brings weakens the inventive talent, by making its frequent exercise less necessary. The invention of an uninstructed man is continually taxed to supply wants consequent on the narrowness of his information; and he will be much less likely, we think, to exercise his natural gifts and apply to his own internal resources, if he can avail himself of the store of knowledge already laid up by the painful industry of his predecessors.

For these and other reasons we might mention, we do not at all anticipate that the more abundant introduction of science into engineering will either raise up abler practitioners than now exist, or extend materially the boundaries of the art. The labour of a great deal of useless invention will no doubt be saved, and invention will certainly begin at a more useful point; but there will be also far fewer who will attempt invention at all, and much of the existing ingenuity must necessarily wither. There will be a larger number of competent practitioners, but fewer, we think, of those great spirits by whom the dominion of art is extended; and though failure will be more rare, invention, we fear, will be less rapid and less brilliant. The natural tendency of all education, indeed, is to redress the unequal dispensations of nature, and while raising up the feeble to cast down the hopes of the aspiring. A natural genius may be oppressed and weakened by the pretended helps of science; and we would warn every academic plodder against supposing that his futile accomplishments can put him on a par with the unlettered artificer, whose innate divinity of soul urges him forward with an irresistible impulse to the highest pinnacle of glory.

Such, then, according to our conviction of the fact, is the secondary place which science properly holds among the qualifications of the civil engineer: our remarks, should they appear inconclusive, may derive some verification from the very remarkable circumstance that our most eminent engineers have risen from those classes which are comparatively rude and unlettered. Brindley, Smeaton, Watt, Rennie, Telford, all were mere artizans like ourselves, and were without the benefits of a scientific education. On the other hand, we do not at present remember any name eminent in science which is also eminent for engineering skill, or for ingenious devices of any kind. Archimedes, indeed, is an exception, and perhaps Watt, who, *later* than the date of his grand invention, rose to considerable scientific eminence; but this only proves that there are some minds called out to eminence by so irresistible a vocation, that even the obstructions of science cannot keep them back from their exalted destiny; and it is manifestly idle to imagine that science has produced the talent it has merely been unable to extinguish.

It may be supposed that our cautions against too great a devotion to science are needless in the case of an institution which professes also to give practical instruction; but this is precisely what renders them the more necessary, inasmuch as the practical pretensions of this College are a complete delusion. This idea, indeed, that it is a practical establishment, is the damning heresy which lies at the root of all its frivolities; and however honestly the affairs of the College may be hereafter conducted, it must and will be a failure so long as, with its present narrow capabilities, it pretends to educate an engineer in the practical part of his profession. To make this education good for anything, the student, on leaving the College, should be qualified to practise as an engineer in the same way as a doctor is qualified to practise after he has passed the Hall, or a minister to preach after having passed his ordination. If the College does not do this it does nothing; and who, we may ask, is likely to intrust a serious engineering work to one of these clever young novices, full of confidence and mathematics, and without a particle of experience? What will it avail for the real purposes of life to have spent considerable time in fiddling with steam-engine models, digging pits, and raising mole-hills over eleven acres of ground; pretending, too, when the Lilliputian tunnels fall in, that it is all done on purpose? Is it upon the strength of such holiday exploits as these that the very estimable youths of this College are to be called upon "to shield our harbours from winds and waves, drain our mines of water, and accelerate the transit of the world?" What capitalist in his senses would think of intrusting the formation of a mine, or railway, or steam vessel, to any of these aspirants? and which, indeed, even of their instructors would be so intrusted? And if such employments be inaccessible, what are these youths to do? They have shut themselves out from all secondary employments under our established engineers by entering this College at all; and established engineers have, moreover, a surplus number of expectants for whom they must first provide. The Government may perhaps do something, and we trust it will, but it is little the Government *can* do in finding employment for such a number; and any such intervention in favour of this College would bring a host of similar applications from Glasgow, Durham, King's College, and other places, which would require to meet with equal consideration. We grieve sincerely at the wreck of time, exertion, and hope which this College must, if the present courses be persevered in, speedily bring about, and are heartily provoked at the apathy, indiscretion, and misconduct which endangers such a visitation, and threatens to exhibit to the world so sad a spectacle as a concourse of ardent and promising young men deluded, impoverished, and undone.

These remarks have drawn out to a much greater length than we anticipated, and we have now only room to indicate as briefly as we can the remedies we would suggest, and which we firmly believe would make the College in every respect successful. And first, we would abolish the workshops, which are a fertile source of ridicule and expense, and we would put a stop to *all* the frivolous handiworks which are carried on within the College. We have already stated that we would put an end to the office of Secretary, and we would also abolish the Professorships of Machinery, Drawing, and Geography. We would, however, create a new Professorship of Drawing, or rather of Design, which ought to have particular reference to Architecture *as a fine art.* The professorships would then stand thus:—

Principal.
Mathematics, Mechanics, and the Steam Engine.
Do. First Master.
Do. Second Master.
Chemistry, Heat, Electricity, Magnetism, &c.
Mining, Mineralogy, Geology, and Geodesy.
Design.
Construction.
French.
German.

History and Composition, Greek, and Latin, and Geography, could be taught by the Principal.

This would perfectly suffice for the theoretical department, and for the practical part we would suggest the following. A proper engine factory should be bought or built, not by the College, but by parties interested in the prosperity of the College, and the management of this factory should be given to a sound practical engineer to conduct *on his own account.* A rent would, of course, be charged, and the occupant of the factory should guarantee that he would keep a certain number of good mechanics constantly employed, and that the college students should be put to work with these steady and skilful men. This, we conceive, ought to be done free of expense to either party; nothing should be paid for the instruction of the students, and nothing received for their labour. The occupant of the factory would, of course, under ordinary circumstances, be advantaged by this arrangement; for the labour of the students would no longer be mere trifling, but real serious work, and for his own sake, he would take care to wean them of extravagance in the use of materials; but at times when there was little trade astir, he might, on the other hand, sustain some loss by being obliged, by his bargain, to keep in employment a superfluous number of workmen.

By these means, the students would be taught the most important mechanical arts truly and thoroughly, and without any expense. By bringing them into communication, too, with experienced workmen, they would derive a vast fund of valuable information quite unattainable through any other channel. To develope still further this beneficial feature, the original project of the College, of opening evening classes for workmen, should be revived, but the charge originally proposed is too high, and should be reduced. The students would thus have it in their power to become acquainted, not merely with the nature of the work produced in their own factory, but of that produced in all others, and would, we think, become in reality all that the College professes and intends.

In regard to the practice of mining, bridge building, &c., it is more difficult to know what to suggest; but the best plan perhaps would be, for the council to make an agreement with some contractor, to permit those students more particularly destined for employment on such works, to pass some of their time in working upon them. We do not, however, attach any great importance to this condition, and believe that the plan pursued by Mr. Vignoles, of visiting public works with his pupils, and explaining the several operations, will in most cases be sufficient. There is little knowledge to be acquired in handling the spade or the pick-axe; and we think it idle to devote much time to such accomplishments. It would be desirable, we conceive, that every student should pass some time in a practical man's office, before his pupilage expires. The offices of the Engineers are of course closed fast; but we think the council might make an arrangement on the subject with some of our larger builders, which would answer the purpose quite as well—perhaps better. We are of opinion, however, that if the students are well grounded in the workshop, the greatest part of the practical difficulty is overcome; and, indeed, an expertness in any one of the mechanic arts wonderfully facilitates the acquisition of all the rest. The first two years and a half of the course should, under ordinary circumstances, we think, be devoted to theory only; the next half year to theory and practice conjointly; and the last two to practice alone. It is a bad plan, we think, to make the mixture of theory and practice extend over too long a period. When the practice is once commenced, there will be little further progress in the theory; and, besides, the students should, as much as possible, begin and leave off work with the men; else they will lose much of the benefits of their instruction, and derange the economy of the factory. It is of course impossible, if this plan were to be carried out, that the College should continue at Putney. It would be better, we think, if located either at Westminster or the Isle of Dogs; or, indeed, in any situation eligible for a factory, and somewhat accessible to mechanics.

We must here close our remarks, and take leave of the College for Civil Engineers. We wish we could entertain any tolerable hopes of weaning it from the errors into which it has fallen, and to which, if persisted in, it will assuredly fall a martyr. The early consideration we have given it, and the large space our present observations occupy, show sufficiently what weight we attach even to its indiscretions, and what great things might, in our judgment, be expected from such an institution, if only wisely administered.

ART. IV.—SELF-ACTING LATHE, FOR PLAIN AND SPHERICAL TURNING, SCREW-CUTTING AND BORING.

By MR. HASTIE, *of Messrs. Scott, Sinclair, and Co.'s, Greenock.*

[We are enabled, through the kindness of Messrs. Scott, Sinclair, and Co., to give our readers a description and drawings of this very ingenious piece of mechanism, which is, indeed, one of the most creditable examples of automatic turning machinery that we have met with. This lathe was set to work as long ago as 1837:—since that time it has been constantly at work, and has been found to operate most satisfactorily: it is not, therefore, to be looked upon as an untested expedient, but as a contrivance, the efficacy of which has been amply demonstrated by experience. It would be superfluous to pass any encomium upon the high inventive talent which this contrivance manifests, both because Mr. Hastie can very well afford to dispense with any praise of ours, and because the ingenuity of the device cannot but be apparent to the most cursory observer.—ED.]

PLATES 1 and 2 are elevations, plans, and sections of the lathe; in which (A) is the bed, or sole plate of the lathe, supported by three strong pillow-blocks (B), sufficiently secured to large stones; (C) the shifting head, with its moveable centre; (D) the fixed head, with its two shafts or spindles; on one of which (E) is a wheel and pinion firmly fixed, and, on the other (F), a wheel and pinion, with the cone of pullies intervening, the pinion being cast with the pullies which run loose on the shaft, and the wheel fixed; (G) the slide-rest, shown in detail in Figs. 8, 9, 10; (H) the main screw of the lathe, for working the slide-rest longitudinally along; (I) a shaft running behind the lathe, for working the slide-rest in barrelling, spherical, and face turning; (*k*) a shaft carried by the pillow-block (*m*), moveable in the circular grooves, shown as described, from the main centre of the lathe; (*n*) another shaft carrying a worm for working a wheel on the end of the shaft (I). The lathe, by means of two spindles (E F) in the fixed head, has two sets of motions; the first, or quickest, being got by fixing by a key, provided for the purpose, the pullies with their pinion to the shaft (F), and throwing the wheel and pinion on the shaft (E) out of geering with the wheel and pinion on F, by the rod (O), which works a spindle (L), having two levers attached by links to the bushes in which the shaft (E) works; and the second, or slowest set of motions, by letting the pullies run loose on the shaft (F), and putting both pairs of wheel and pinion into gear; by which changes, the number of turns made by the main centre of the lathe in a given time, can be varied at the rates of 1 to 35.

Fig. 4, is an end view of the lathe, as arranged for parallel turning; the worm (*b*) on the shaft (*k*) being in gear with the wheel (*c*) fixed on the end of the main screw, the slide-rest is moved longitudinally along the bed proportionably to the speed of the main centre, and at a rate depending on the number of teeth in the wheel (*c*), for which there are three with 30, 40, and 50 teeth respectively, and which, since the pitch of the main screw is one inch, afford the means of varying the feed, or longitudinal travel of the cutter, from 1-30th to 1-50th of an inch for every turn of the main centre; and this in either direction, by means of the two bevel wheels (*d d*), which can be either thrown into gear with the bevel-wheel (*d*) on the end of the shaft (*k*). The pillow-block carrying the shaft (*k*) being moveable in circular grooves, described from the main centre, accommodates the position of the worm to the size of the wheel on the end of the screw (H).

Fig. 6, is an end view of the lathe; and fig. 9, a plan of the rest, as arranged for spherical turning. The worm on the shaft (*k*) giving motion to the shaft (I), works the bevel-wheel and pinion (*e f*), which again, by means of small wheels, work a spindle (*g*), carrying a worm in gear with the wheel (*h*), to which wheel is fixed, as shown in drawing, the upper parts of the rest, carrying the tool; and, since the bevel pinion (*f*), which is cast solid with one of the wheels leading to the spindle (*g*), runs loose upon the spindle or screw (K), the under parts of the rest are stationary, and the upper parts move in circles concentric with the wheel (*h*), and hence the cutter will form a spherical surface, if the centre of the wheel (*h*) be vertically below the axis of the lathe, and the radius of that spherical surface will be equal to the distance from the point of the cutter to a perpendicular line passing through the centre of the wheel; but if that centre line be not coincident with the axis of the lathe, the surface described will be convex or concave, depending on the relative positions of the centre line of the wheel, the axis of the lathe, and the point of the cutter. To arrange the lathe for face turning, the wheel in the spindle (*g*) is taken off, and the bevel pinion (*f*) secured to the screw (K), which has the effect of moving the upper parts of the rest transversely across the bed of the lathe.

Fig. 5, is an end view of the lathe; and Fig. 9, a plan of the rest arranged for barrelling, which, in contradistinction to parallel turning, is giving a gradual swell in the middle to a shaft or rod. In this arrangement, both the shaft (I) and the main screw of the lathe are set in motion; so that while the tool, by the spindle (*g*) and wheel (*h*), is moving round in a circle, the rest is moving longitudinally along the bed of the lathe; thereby communicating to the tool two motions, the resulting one being convex to an extent depending on the relative motions of the shaft (I) and the main screw; the position of the centre of the wheel (*h*), in relation to the axis of the lathe, and the distance of the point of the tool from the centre of the wheel; all of which can be varied; and, therefore, the extent of barrelling, to suit the particular case in hand: as in the case of parallel turning, so in barrelling, the progressive motion of the slide-rest may be varied from 1-30th to 1-50th of an inch per tooth of the main centre.

Fig. 3, is an end view of the lathe as arranged for screw cutting. In this arrangement there is a pillow-block, with a slide moveable for adjustment by a screw, carrying a stud, on which is placed the intermediate wheel for connecting the wheel on the main centre of the lathe with the wheel on the end of the main screw, substituted in the circular grooves instead of the one carrying the shaft (k). The pitch of the screw of the lathe is one inch; and therefore the pitch of the screw being cut is equal to $\frac{\text{No. of teeth in wheel } (p)}{\text{No. of teeth in wheel } (q)}$ of an inch; which may be varied to any extent by varying the wheels placed in the main centre and the main screw to 80; and then every alteration of 10 teeth in the wheel in the main centre corresponds to an alteration of an eighth of an inch in the pitch of the screw.

A very interesting example of the use of the spherical turning apparatus of this lathe is the simple and elegant manner in which it turns the eyes of side rods. Fig. 11, is a cylinder or air-pump side rod for a marine engine, of which the end is turned, by means of the spherical apparatus, by only two settings of the tool. In consequence of the upper part of the eye of the side rod being turned by only one setting of the tool, it might be expected that a peak would be formed, as shown in dotted lines at (F), yet such is not the case, and the end is rounded off to a species of hyperbola. This becomes at once apparent, by considering that the solid of rotation, of which the upper part of the eye forms a part, is a cone bulged or convex in its length; and the outline of a slice taken parallel to the axis of the cone is hyperbolic.

[Since the foregoing was put into type, and the plates completed, we have received a number of the Glasgow Mechanics' Magazine, which contains a plate of the same machinery, and a description almost verbatim. It is needless to say, that we accepted Messrs. Scott, Sinclair, and Co.'s communication under a false impression; and, had the steps already taken not been irretrievable, would have returned it to them. We promise our readers to be more careful for the future how we accept such meretricious favours.—ED.]

ART. V.—CHEAP RAILWAYS.

Ensamples of Railway making, which although not of English practice are submitted with practical illustrations to the civil engineer and the British and Irish public. London: JOHN WEALE. 1843.

IT will be a question, we believe, with the purchasers of this volume whether it consists of a single book or of three books disguised under the insignia of an integral dissertation. For our own parts, we do not profess to have made up our minds on this important subject, or rather, perhaps, have no anxiety to state the result of our cogitations, and we shall only offer a few such slight illustrations as may put our readers in possession of the main features of these *Ensamples*, and from which the sagacious may perhaps infer what our judgment would be if we were compelled to be more explicit.

In the publication of this volume there is one extraordinary praise due to Mr. Weale, and which must be remembered in his favour in his accounting with the public: he has been actuated solely by the desire to open up fresh fields of employment for the engineer, so that the superfluous talent at present running to waste in that profession may find new channels for its profitable application. The price of the work, therefore, is wonderfully low—not greater, indeed, than is sufficient to cover the expenses of production; and we do hope that the public and the engineering profession will manifest a becoming sense of such unusual disinterestedness, and be prepared to award corresponding praise, and exercise corresponding lenity.

The first part of the work is written by Mr. Weale, and its purpose is to show that the advantages of our railway system have been wonderfully restricted by the expensive modes of construction pursued in this country. The railways in America, he shows, are as efficient, and are made at a vastly decreased cost; and although they may not be in many respects as durable, they are on the whole much more profitable. It is much better, he says, to construct a work which will pay a large per centage, even though it last but for a short time, than to construct a work which will last for ever and never pay at all; and this, he says, is the relation which on the whole subsists between the English and American railway systems. In many of the less-frequented tracts of intercommunication in England and Scotland, and especially in Ireland, where railways of the common description would never pay, railways on the American plan might pay exceedingly well, and would not only be a profitable investment for capital, but be the means of creating employment for the countless engineers who are left without occupation since the completion of our great railway lines.

The second part of the work is evidently of American manufacture: it consists chiefly of specifications of American works, and is adorned with a fair proportion of the vulgarisms and new coined words which are characteristic of the American language. This portion is, we presume, a contribution of Mr. B. F. Isherwood, an American engineer, as we understand, and whose name is attached to the numerous plates by which it is illustrated. It consists altogether of an account of the mechanical works of the Utica and Syracuse Railway—one of the most successful works in America—and is, we think, a valuable contribution to our knowledge on the subject of American engineering. The chief peculiarities of the American railways, of which this is a favourable specimen, are the plentiful use of wood in all the constructions, and the employment of steep gradients: the viaducts are for the most part of timber; and bogs are crossed, not by the toilsome and expensive expedient of consolidating them with earth and stones, but by driving piles into the morass, until they rest on the hard bottom, and then carrying the railway across on the top of them, as if on stilts. Single lines of rail are employed as often as they can be made in any way sufficient for the traffic. This system, in conjunction with the electric telegraph, is now coming into use in this country, and we anticipate from it the happiest effects.

The third part of the work is an account of the Belgian Railways, by Mr. E. Dobson; and consists chiefly of translations and compilations from official documents. The Belgian Railways hold an intermediate position, as regards the expense of their construction, between the American and English kinds; and, in many of their particulars, manifest much ingenuity and skill. This is certainly the best executed part of the work, involves a great deal of research, and manifests no inconsiderable degree of ability. Mr. Dobson is a far more graceful and pleasing writer than we usually meet with among the engineering *cognoscenti*. We hope to have more of his acquaintance.

Such is a brief outline of the contents of this work. In his new capacity of author, Mr. Weale has acquitted himself beyond our expectations; and most of what he says contains much good sense, and is said very well. On the whole, however, we prefer a systematic treatise to a number of detached pieces; and we think it the fault, indeed, of many of the works which issue from Mr. Weale's manufactory, that they want unity and cohesion. A collection of independent papers can never be made to constitute a treatise by being classed under one name, or bound up in one volume: such documents properly constitute only the *materials* of a work, and should never aspire to be looked upon as a work itself. Mr. Weale would do well to avoid such incomprehensible eloquence as the following:—

> "Surrounded by conflicting, unpromising, and perhaps misguided interests, the great and talented leader of the present government has much to contend with, much to consolidate, in carrying on the affairs of the empire; but it is evident, on *remarking the appliances of his mind*, that his views with regard to internal and national improvement will shortly lead to important changes of a commercial nature; and that a thorough investigation of the resources of the country, the means by which wealth is acquired, if appropriated with a due regard to individual and national benefit, will constitute an important feature in the policy of our present rulers."

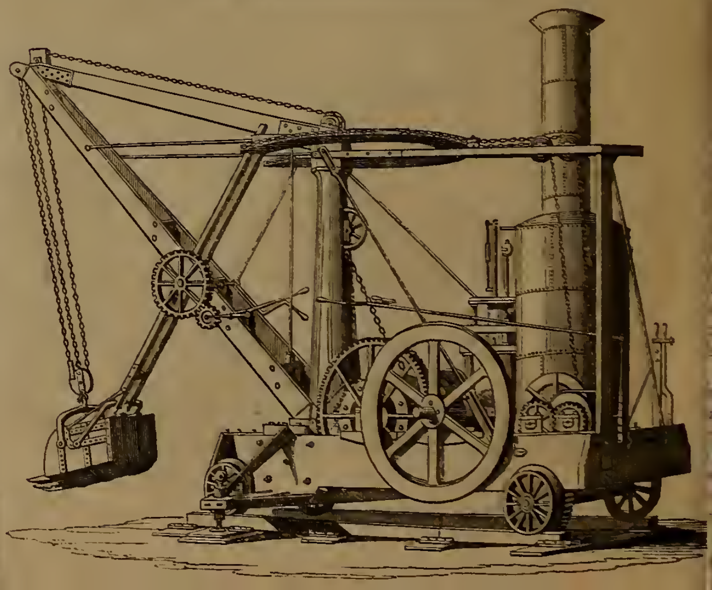
In the following remarks we perfectly concur:—

> "In concluding these preliminary observations, we venture to offer some few suggestions to those who may be more particularly interested in the projects now contemplated for an extension of railway communication in various districts of the United Kingdom. 1st, A strict regard to economy, as the basis of such constructions; 2ndly, the adoption of such legislative enactments as may best control the expenditure in all its ramifications; and, 3rdly, the selection, from the maximum shareholders, of such only as are willing to discharge gratuitously the duties of chairman, vice-chairman, and directors."

Mr. Weale has certainly struck the right key: economy is indispensable to profit, and profit is the measure of success. In most of our great railways,—in the Great Western, for example, and the London and Birmingham as well,—there has been a wanton waste of money; and we sincerely believe that much of the distress under which we are now labouring has been brought about by these extravagancies. Every penny uselessly spent on public works, of which utility is the professed object, is just as effectually lost to the nation as if thrown into the sea, or lost by war, fire, or any other dreadful visitation: and we think those who have lavished the wealth of the nation in rearing eternal monuments of their own extravagance, and superinducing a state of paralysis in other departments of industry, should be held up to universal contumely and execration.

These scattered remarks are all we can now afford to give. Our readers will find the work worth their perusal and—their money.

THE AMERICAN EXCAVATOR.



ART. VI.—OUR CLUB.

No. I.

O whiskey, heaven-descended spirit,
Nurse of invention, wit, and merit,—
Why, loved one! why so long denied?
Lay'st thou thine ancient power aside?
Arise, as in thine elder time,
Warm, energetic, pure, sublime,
And prove again, O spirit fair!
What once you proved, and once you were.

SCENE, *the Club Room. One table and six chairs. Time*, 8 P.M.

Sederunt SIR JONAH, MONTGOMERY, GRAY, *and* PUNCH-BOWL.

GRAY (*mixing the toddy.*) This bilin' water is jist uncommon strong: it tholes dooble its ain measure o' the pure aka veety.

SIR JONAH (*poring over a manuscript.*) A very excellent article; we must certainly find room for it: the subject is one of commanding interest, and deserves to be profoundly and perspicuously treated.

GRAY. What div ye ca' the teetle? The pe-fe-fe-feesi! Did I ever! The second o' Ezra couldna haud a caunle till 't.

SIR JONAH. The Physiology of the Steam-engine; and here 's another, styled the Anatomy of the Steam-engine.

GRAY. Na, na, that winna dae; it 'll fricht the folk a'thegether. Anawtomy! It carries an awfu idea o' cuttin' up deed men.

MONTGOMERY (*sipping his toddy.*) Not sweet enough for me: the sugar.

SIR JONAH. An association, certainly, not one of the most agreeable; yet I think the title expresses the purport of the paper rather felicitously. What title would *you* propose?

GRAY. Weel, its no verra easy to tell that: the fac' is, the Inglish langage is unco defeecient—

SIR JONAH. Might not the Scotch language assist you?

GRAY. There's anither o' your polished sarcasms—you're gran' at cuttin' folks' throats genteelly. Divna ye ken, sir, that a shinin' rapier is jist as deedly a weapon as a roosty gully?

SIR JONAH. Nay, nay, I did not mean—

GRAY. Dinna fash wi' ony excuses; I'm no easy hurted, an' was na speakin' for mysel: but anent your quasten, I ken Inglish brawlies; and, if I likit, could speak it fine; but why should I forsake the heevenly harmony o' my native tongue? I hae nae reason to be ashamed o' my kintra or my langage; an' never will I rear exotic idols in the holiest shrine o' my faithers.

SIR JONAH. You wax eloquent, Alexis.

GRAY. An' hoo can I help it whan I talk o' my native country, an' that country Scotland? True eloquence is nae artificial stream sustained by the devices o' a curious engineery, but a fountain o' livin' waters gushin' spontaneous frae the agitated heart—like the Geysers o' Iceland, which rush frae the deep an' warm channels o' the earth's bosom, to melt a frozen wilderness into fruitfulness an' beauty.

SIR JONAH. Magnificent!

GRAY. My heart throbs an' burns within me, whan I think o' the gowany braes, an' wimplin' streams, an' murmurin' linns o' my native lan',—o' the haunts consecrated by the associations o' childhood, an' the abodes hallowed by the images o' maturer years; and liftin' my reverent eyes to heaven, I swear by HIM who sitteth on the throne, an' liveth for ever and ever, that I will never forget Scotland, or cease to cherish her fondest recollections. Yes, my country! devotion to thee still reigns paramount in the hearts o' thy children; and although the rainbow o' thy hope may have waxed dim in the rayless light o' these more tranquil ages, yet if the rains again should beat, an' the wunds again should blaw, it will brighten into a' its original lustre, an' again irradiate thy universal heaven.

SIR JONAH (*aside.*) Jacobinical to the back-bone.

GRAY. Thy woods an' thy waters, thy muirs an' thy mountains, are always dear to me; an' dearest o' a' is the desolate place o' my birth. To it I owe not only the duty o' a son, but the sympathy o' a brither; for, am not I desolate also?

SIR JONAH. Subtle, but full of true poetic feeling: such associations, though elusive, are no doubt exceedingly powerful, and are probably at the root of every emotion of sublimity and beauty excited by the spectacle of the works of nature. The rugged and cloud-capped mountain, the turbulent and impassable cataract, and the primeval forest, where the red deer finds a shelter, and the gigantic pine spreads its plumage to the sun,—these excite not pleasurable emotion by virtue of any occult properties of form and colour, but by the hidden sympathies they call into being, stimulating the imagination to people them afresh with the chieftains of former times, and to repeat all the events which have rendered their names famous.

GRAY. The spirit o' my country is upon me. There, on the banks o' the windin' Carron, Wallace marshals his followers: noo at their head he rushes to the battle; an', after performin' prodigies o' valour, retires before overwhelming numbers to the fastnesses o' the befriendin' mountains: noo again he sallies forth, carryin' terror into the strongholds o' the enemy, an' brichtenin' the hopes o' patriot hearts: noo he is betrayed into the power of the ruthless Edward: an' noo—an' noo—O misery!—he is a mangled corpse—havin' suffered the death o' the vilest malefactor. But the bluid o' the righteous will na sink into the dust, but rises to the throne o' an avenging Providence. An' lo! the Bruce comes forth, an' the faithfu' o' the land gather round him—a phalanx strong as the rock o' the ocean, and dreadfu' as the swirl o' Corrievrechan. But the dark pooers o' oppression league thegether a' their micht, an' pour forth a' their forces to quench the spark o' freedom, an' exterminate the brave defenders o' their native lan'. Yonder, windin' roun' the base o' that frownin' craig, comes the vanguard o' the presumptuous Edward; an' the ee may trace the wavin' line o' armed invaders, stretchin' far, far awa, owre hill an' valley, till lost in the dimness o' the distant horizon. An' hark! a peal o' insolent defiance bursts frae a thoosan' hostile trumpets; but the patriot rocks hurl back the challenge wi' their thoosan' indignant an' unearthly voices. An' noo the fury o' the tempest bursts upon the field o' Bannockburn. It swells—it rages—it dees awa—an' there, rising through the gloom, stans the bulwark o' liberty unharmed an' unshaken,—firm as the rugged an' impregnable promontory which lauchs at the waves that wrestle aboot its base. But whaur are noo the hosts o' the mighty? Whaur are noo the bricht panoply an' gorgeous plumes o' the chivalry o' the Sassenach? Whaur are noo the flauntin' banners that polluted the gracious wunds o' heeven, an' insulted the purity o' a virgin sky? Melted awa like the visions o' fancy, or the mists on the broo o' Morven',—furnishin' anither example o' the premary an' immutable truth, that the sons o' the mountain will never consent to weer the badge o' slavery.

SIR JONAH. Inimitable! Such a picture could only be drawn by the pencil of genius and sensibility.

GRAY. Years pass awa, an' Scotlan', amang internal distractions an' stupendous change, still enjoys the liberty for which her sons had contended. But noo an attempt is made to wrest frae her that pure an' simple faith which had become enshrined in the hearts o' her children, an' impose in its stead the unholy rites an' unsaving influences o' episcopal domination. An' see hoo the people rise as ae man, to spurn frae them the hated measure—they grasp their shields, an' draw their swords, an' sweer the oath o' the covenant—sweer to spill their heart's last drap in defence o' that kirk which is founded on the Rock o' Ages. Armed, an' in secret, the Covenanters assemble to worship God after the manner o' their fathers: an' what avails the power o' kings or princes in arrestin' or extinguishin' the flame o' true devotion? There, in the bosom o' that deep glen, are a resolute an' stalwart band, wi' swords at their sides, an' Bibles in their han's, listenin' wi' their wives an' bairns to the pious exhortations o' that auld an' reverend man: an' noo their voices join thegether in celebratin' the praises o' the God for whom they suffer, an' the light o' whose countenance is their glorious reward; an' the soun' rises to the throne o' mercy, mingled wi' the hallelujahs o' nature—the scream o' the eagle, the roar o' the cataract, an' the echoes o' the adorin' mountains.

SIR JONAH. Overwhelming!

GRAY. An' is there amang that group ane wha wadna dee a thoosan' deaths rather than abjure his faith? The reverend preacher, whase silver hair noo floats in the breeze, was thrown into a dungeon, where he deed a martyr to the truth. Some perished on the battle-field, an' others, by mair cruel an' lingerin' deaths, were dismissed to the glories o' Paradise. An' yon bonniebit lassie, sittin' on the grass, an' leanin' on her grannie's knee—drinkin' the pure waters o' the Gospel, like the openin' rose which drinks the balmy air an' pure sunshine o' her native hills,—did that delicate flooer shrink frae the keen blasts o' persecution, an' purchase life an' a' temporal pleasures by the forfeiture o' an immortal croon? No!—tied to a stake on the sea-shore, the waters rose around her—the light o' heaven shone in her serene an' pallid face, an' she disappeared in the foamin' surge, as the sunlicht dies upon the ocean, when hastenin' to give its lustre to a happier sky.

SIR JONAH. Sir Walter never exceeded it!

GRAY. But the measure o' iniquity is full—the hour o' retribution is at han'—the thunder-cloud has lang been gatherin' in the horizon; an' noo it bursts wi' an explosion that rends the constitution asunder, an' buries the throne in its ruins. An' the voice o' lamentation is heard in high places—the scaffold streams wi' the bluid o' royalty, an' princes become pensioners in forrin lan's. But the kirk rises frae the wrack mair beautifu' than ever: the dark waters o' tribulation hae flowed over her, an' she emerges frae them wi' a purer an' benigner lustre—like the purified earth, resplendent in the beams o' the mornin' sun, as it rose aboon the waters o' the deluge.

SIR JONAH. All Scotchmen do not look upon the kirk with so much complacency.

GRAY. A' Scotchmen dinna love what the kirk *is noo*, but they a' love what the kirk *has been*. In aulden times the cause o' the kirk was the cause o' liberty baith ceevil and religious.

SIR JONAH. Which is scarcely the case at present.

GRAY. No; an' therefore the kirk is fast fadin' frae the affections o' the people. She noo allies hersel wi' episcopacy, an', through it, wi' aristocracy. She cares less for the puir man's woes, an' visits less frequently the puir man's dwallin'; she is departin' frae the apostolic simplicity o' former days, an' is ceasin' to be the kirk o' the people. Therefore is her gold become dim, an' her fine gold changed; an' a fire has been kindled in her Zion, which hath destroyed the foundations thereof.

SIR JONAH. The kirk has lately made great exertions to secure to the people the right of electing their own ministers.

GRAY. She has; an' if those exertions be pure an' single-minded, the people oucht to be gratefu' for them. But the people hae been sae often deceived, that they are naturally suspicious; an' the predominant impression certainly is, that the kirk is fechtin' only for her ain private enns. The ministers, it is imagined, only want to get the pooer oot o' the han's o' the patrons to keep it in their ain; the richts o' the people being rendered nugatory by some by-law or ither manœuvre o' the General Assembly.

Sir Jonah. An uncharitable surmise; yet not altogether unjustified by the whole demeanour of the clergy. The people can hardly suppose that the clergy care much for their interests, when they devote their whole time to an idle church agitation, instead of uniting to alleviate the dreadful distress which at present covers the land. The proceedings of the Non-intrusionists, however conscientious they may be, indicate a marvellous ignorance of human nature, and *must* be unsuccessful so long as the present courses are persevered in. Their language to the people is virtually this:—It is true you are dying of cold and famine; it is true your starving families are wandering about the country, without a roof to shelter them from an inclement sky, and scarce a rag to cover their shivering limbs; it is true you can obtain neither maintenance nor employment, and the hopes of ever seeing a better day are fast fading from your hearts: but what signify these pains of the flesh? will ye not have a voice in the election of a preacher?

Gray. Preceesely sae; an' what wad thae verra releegious gentlemen themselves care aboot kirk agitation gin they were in the predeecament o' the bulk o' the operative classes? Preachin' an' prayin' will na feed a starvin' multitude; nor are folk deein' o' privation likely to care muckle wha elecks the minister, or whether there's a minister elecket ava.

Sir Jonah. The ministers have begun at the wrong end. They should first have obtained the confidence of the people; with the aid of which, they might have accomplished their object; and without which they never can. That confidence is not to be commanded, but must be won; and is to be won only by identifying themselves with such measures as are calculated to ameliorate the temporal condition of the great body of the working classes.

Gray. Dignity is the disease o' which establishments generally dee—they'll never believe themsells in the wrang, an', by a timely remedy, avert a fatal termination; but persevere in their daft coorse, as if they thoucht themsells infallible, and that wrang could be turned into richt, merely because it had the advantage o' their predilection. The unholy heat exhibited in the Non-intrusion controversy, has broocht baith sides into discredit; an' the trash preached up at this time o' day aboot spiritual pains, penalties, an' jurisdictions, is only lauched at by sensible folk, an' wad hardly be avowed by the Scarlet leddy.

Sir Jonah. "Whom the gods design to ruin, they first infatuate;" and the clergy, with the best possible intentions, will probably persevere in their mistaken policy, until they bring down the church. There is no sincerer Non-intrusionist than I am; yet the evils of intrusion, great though they be, are not the most pressing the people have to endure, nor the first to demand redress.

Gray. The Intrusion grievance has existed mony a day, an' micht shairly exist twa or three years langer withoot ony material detriment. Gin the clergy were to let the Intrusion quasten lie still for a wee, an' join wi' the people in the advocacy o' sich measures as micht mitigate the present distress, an' avert sich calamities for the future, the people wad afterwards poor their weicht into the Non-intrusion scale, an' the quasten wad be carried in a twinklin'. Without the help o' the commonalty, an' wi' the aristocracy against them, the clergy may spoot an' yaumer to the end o' time withoot makin' the slichtest progress.

Sir Jonah. Independently of the aid which such a course would give to the adjustment of the Non-intrusion question, it would be productive of the happiest effects to the cause of true religion, which has no more formidable enemy than abject poverty. Privation, in ordinary natures, will blast and embitter the heart, and call up emotions inconsistent with religious sentiment; but the temporal wants once duly supplied, contentment and gratitude will follow; and the religious aspirations natural to man will rise into full fruition. In every community, it is true, profligate malcontents will occur; yet, in a free and prosperous community, such persons will be wonderfully rare, and must be incapable of endangering the public peace, or debasing the national character. The evil spirit complained of among the people, though no doubt fomented and acerbated by designing demagogues, owes its origin and chief growth to the insufferable miseries of our working population.

Gray. An' hoo div ye propose that the clergy should contribute to the alleviation o' these miseries?

Sir Jonah. By studying Ezekiel less, and Adam Smith more; by investigating the causes of those revulsions in our trade and manufacture, which periodically shed over the land such deplorable distress; and, while shunning religiously all political partisanship, lending their aid to the enforcement of such measures as will either remove the cause, or neutralize the effect.

Gray. O, gin the kirk were only to put hersel' at the heed o' the people, in demandin' their just richts, to what a glorious elevation she wad again rise!

Montgomery. Nhro, hnro—nrro, hrro—nrrrou, hhrrrau—nhro, sphro.

Gray. The unmainnerly keowt—actwally snorin' there, whan I'm talkin' o' Scotlan' an' the people's richts!—Hearken! it's "Scots wha hae."

Sir Jonah. Liker the old hundredth on the hurdy-gurdy. It is rarely he is so somnolent; but our discourse has probably been more soporific than usual.

Gray. Hullo!—Munty——! (*shaking him.*) Od, he's hard to wauken. Jist gie him a sniff o' the Glenleevet hartshorn—a spoonfu' in this glass—that'll dae—yes, smell till't, my bonnie callant!—There, see hoo, by the gracious instinct o' nature, he opens his mooth at the smell o' the aka veety!

Montgomery. Yes, gentlemen, a toast such as that deserves to be acknowledged in a caulker!—primed?—higher, higher. Hip, hip, hur—. *(Rubbing his eyes.)* Hallo, old buck, have you finished your gl—, your sermon. I had no hope of holding out till the "*Tenthly*," and therefore surrendered myself at once into the arms of Morpheus.

Gray. An' wha's she?

Montgomery. A friend of yours, whom you meet almost nightly.

Gray. Are you no ashamed to sit there an scandaleeze a douce richt-minded man by retailin' the lees o' some drunken randie. An elder o' the Relief to shew sae little regaird to Maister Nickel an' the ten commandments as to—toots! it's a *stipid* cawlumny.

Sir Jonah. Come, Montgomery, rouse yourself up and give us a few verses of one of your favourite songs. We've been as dull to-night as a convocation of Dutch theologians.

Gray. Couldna' ye sing or receet somethin' off-han'? You used to be gay gude at that sort of trade.

Sir Jonah. A leviathan among the common fry of extemporizers!—a comet in the milky way!

Gray. In the milky way, are ye? Man, I thocht yon were still in the airenmongery way. An' hoo's tred in the milky line? I hope ye div na keep your kye in Pump-court.

Montgomery. No, in the shades of the Olympic.

Sir Jonah. Where the voice of the stars may be heard nightly between the hours of seven and twelve.

Gray. Na, na, that winna dae; the beast in the Revelations is wunnerfu' eneuch, but stars hauding a discourse like Christian creturs—na, na, na.

Sir Jonah. Let it be an impromptu then, my son.

Montgomery *(sings;)*—

There is not in all London a club-room more sweet
Than the dear little room where our Artizans meet;
Oh! the last rays of feeling and life must depart,
Ere the love of that club-room shall fade from my heart.

It is not the lure of a redolent store
Proclaiming the care of a wise providore;—
'Tis not for the bowl which oppresses the table,
Inviting to tipple as long as we 're able;

Nor the great planished kettle which sings on the trivet,
Nor the brazen-bound cask of unchristened Glenlivet;
No, that feast and potation ne'er conjure a bill—
Oh no! it is something more exquisite still.

'Tis that friends the beloved of my bosom are present,
Enhancing my joy, making pleasure more pleasant;
And the meanest back room may a Paradise prove
When containing the friends and the liquors we love.

Sweet Artizan's club-room how calm could I rest
On thy carpetless floor with a jug of thy best;
Subdued by its perfume sensation would cease,
And rapture be crowned by oblivion and peace.

Gray. It's no that ill to be sung jist aff-loof—here 's t' ye, Sir.

(*Enter* Gardiner.)

A gentlemen desires to see Mr. Gray.

Gray. Wi' your leave, gentlemen, ask him ben—(*Exit* Gardiner)—it's my frien', Maister Aundray Wolf.

Montgomery (*starting up.*) It's not fair to bring that hypocrite in upon us; he shall not enter; the same room shall not hold him and me.

Gray. Hoot toot; there's nae need for brastlin up that wye; its no like a Christian man ava. If he be a wee bitter as you say he is, have na we a' oor fauts, and should na that conseederation mak us a wee mair indulgent to the fauts o' ither people?

Montgomery. It is not his bitterness that I condemn, but his duplicity. The misfortune of being a Wolf is to be overlooked; not so, the treachery of being *a Wolf in sheep's clothing.*

(*Enter* Gardiner, *ushering the intruder.*)

Yes, sir, there are two gentlemen besides. This way, sir—yes.

Montgomery (*in dead earnest.*) As this is the first time, sir, we have met since a recent occurrence, it is right that I should state my opinion of your conduct, so that you may perfectly comprehend the position in which we mutually stand. You have, I conceive, proved yourself to be a person of very questionable honesty, and are certainly unpossessed of a particle of gratitude.

Mr. Wolf (*with considerable tragic action.*) That's more than mortal man can thole. What! a regular attender at the tabernacle, and a candidate at this blessed moment for the office of precentor, to be called a cheat to his verra face! Potiphar's wife didna inflict a greater injustice;—but as it is written, "the righteous shall suffer much tribulation;" and me and Joseph have been muckle wronged.

Montgomery. Only by your own misdeeds. It is fatal to any man's character for honesty to assert as facts to-day what he disclaims as fallacies to-morrow. His first statement must have been false, or else his second: in either case, he destroys his credibility for ever afterwards. Opinions may vary with the degree of information possessed by the individual, but facts are immutable, and any attempt to disguise or overturn them so soon as their acknowledgment becomes inconvenient, only indicates that every spark of honest and independent principle has been extinguished, and its place supplied by meanness, prevarication, and fraud.

Mr. Wolf. I had to think of my duty to more than one individual.

Montgomery. You should have thought only of your duty to God and your own conscience: that would have comprehended all others.

Mr. Wolf. People situated as I am cannot be so independent.

Montgomery. Then you were constrained to pursue the course you adopted?

Mr. Wolf. Most destenctly.

Montgomery. And upon what compulsion?

Mr. Wolf. A refusal involved a very obvious alternative.

Montgomery. I disbelieve the calumny *in toto*. Your employers, I know to be honourable men, and *are not* the Jesuits you would represent them. But even had the case been otherwise, your penetration must be small indeed if it cannot discover that the very compliance with an iniquitous mandate, had such a mandate been given, must have sunk you irretrievably in your employers' estimation. For how must they, of necessity, reason? If this person has so little principle or fidelity as to adopt that course which he imagines to be most inimical to a benefactor, as well as inconsistent with his own previous declarations, merely to further his personal interests, what is to prevent him from serving us in the same manner as soon as it becomes to his advantage to do so?

Sir Jonah. An inconstant friend always injures himself a thousand times more than any other person. He shows clearly that he has no principle and no heart, and every one imagines, though no one perhaps says so, that under analogous circumstances he would himself be served in precisely the same manner.

Gray. Weel, weel, it's a' owre now, and canna be helpit. By-ganes should be by-ganes, as my worthy faither used to say; sae, let's hear nae mair about it.

Sir Jonah. In all such affairs there is invariably a deal of misapprehension, and every one, especially if his feelings be unusually sensitive, should be very distrustful of his own judgment.

Gray. That's a verra sensible observation; it's preceesely the best an' maist warm-hearted men whose judgments are the likeliest to be overpowered by their sensibeelities.

Montgomery. The matter rests as best could have been wished; the one party has not been sold, nor the other materially injured; and whatever misconceptions and estrangements may have arisen, time and enquiry will, it is hoped, dispel them all—

"For naught was done in hate, but all in honour."

Sir Jonah. Mr. Wolf, you 've been sitting all this time without a glass before you. That case contains wine, and this spirits, and the emperor of China is not yet visible in the punch-bowl.

Mr. Wolf. I do not make a practice of drinking spirituous liquors, but I'll take a glass of that toddy there, just to drink reconceeliation.

Gray. Hurrae, hurrae, hurrae!

Sir Jonah. You've got the West India mail vessels now beside you.

Mr. Wolf. Yes, and wish sincerely they were all at Botany.

Gray. Peety me, but that's a fearfu' mismanaged concern; it's jist scandalous to see the gripe thae derectors reteen o' the reins o' government in spite o' the universal ootcry o' the proprietary, an' the ruin an' contempt they hae brocht upon the enterprise.

Montgomery. If the directors were members of a government instead of members of a company, they would certainly be impeached, and perhaps lose their heads. They have, I conceive, seriously damaged their reputation both as merchants and as gentlemen.

Mr. Wolf. And then, preserve us, to see their ships! so dirty, and disorderly, and mutinous. Half of the men deiu' of starvation, and the other half of the drops o' brandy.

Gray. Puir Airchie Ramsay has aneuch adae amang them. He'll sune be a perfect anawtomy.

Mr. Wolf. Yes, he compleens much, as well he may; mair especially o' the heat and hunger; forbye the yallow fivver and dry rot. I had a lang letter frae him latcly, frae Jamaycay, or some ither part forrin, brocht hame by a laud they ca' Tampico—at least his name was at the heed o' the letter, which I jalouse is the forrin fashion.

Gray. Ou aye, an' the hame fashion as weel, I'm thinkin', since thae anveylopes cam' in. But Airchie maun be forgettin' his breedin' amang thae blackamoor barbaurians. In Scotlan' we would say, "favoured by Tammas Pico, Esquire."

Mr. Wolf. It was jist aboot the time poor Allan Cunningham deed.

Sir Jonah. An irreparable loss.

Montgomery. Yes, our constellation of poetry has set. Byron, Scott, Campbell, Wordsworth, Southey, Coleridge, Rogers,—all either dead or superannuated.

Gray. Forbye Burns, an' Allan, an' the Shepherd, tis a degeenerat' age. I wush I'd been brocht up to the poetry tred mysel'—O! I'd hae keepit up the honour o' Scotland.

Montgomery. Poo, poo! Poetry is not to be mastered like iron working. A poet must have *soul;* and you surely do not pretend to possess that, —unless, indeed, it be the soul of a rhinoceros.

Gray. Ye're a wee impiddent ma—man. The O-de-Cologny scrabblers —the shilly-shallyin' carpetcers imaygin, I ken, that poetry grows only in drawin'-rooms an' flooer gairdens; an' that a spark o' genie canna lurk aneath a leather daydley; but you oucht to hae mair sense: there's mony a gude kernel in a gay rouch shell.

Montgomery. Well, tip us a stave of something—something extempore.

Gray. Somethin' what? Na, ye ken I'm nae sang tinkler; tho' if I had been bun' apprentice to that tred, insteed o' i' the smiddy, there's nae sayin' —but I'll jist gie ye "She's a' my fancy pented her."

Omnes. No—no—no.

Sir Jonah. A beautiful song—full of true pathos, but too sentimental for the present occasion. Something *aff loof,* as you call it, and merry.

Gray. Ochone! Ouchu—ouchu—ouchu—Echeh—Hcyeym.—(*Sings.*)

Noo, my hearties, fill your glasses;
What though you for ance be fou?
Here's to gude an' bonnie lasses,
An' to honest men an' true.
Scotlan'! may her children cherish
A' the virtues o' their sires;
Nobly live, or nobly perish,
As their country's cause requires.
  If there' ony
  Carlin stony
Wadna for his country dee,
  Sic a traitor
  To his natur
No to staun' for liberty,
Hang him up as high as Haman,
Scot maun ne'er dishonour Cramond.

Sir Jonah. A little less vehement, my dear Alexis; your energetic action puts all the bottles in jeopardy. Cannot you bring in something in honour of Scotland's proficiency in art and science?

Gray.

Scotlan' ance in arms the peerless,
Noo in arts the foremost too,
Smilin' peace, an' battle fearless,
Weave a garland for thy broo.
Sons o' yore upheld thy glory
By their valour in the fight;
Science writes thy modern story
Wi' a ray o' magic light—

(*Here an unlucky sweep of the bard's right arm demolishes three black bottles, and overturns the Argand lamp into the punch-bowl.*)

Sir Jonah. Whew!—Gardiner!—Magic light, indeed!—much liker magic darkness. Grope for the bell.

(*Enter* Gardiner, *in considerable alarm.*)

Sir Jonah. Lights! lights!—we're all in darkness.

Gray. Ye need na tell him that:—the daurkness is to be seen wi' half an ee. It's an unco' awkard lang shankit caunlestick; the great glass heed o' the thing maks it sae tap-heavy, that, if ye only gie a wink, it'll tummel owre direckly.

(*Enter lights and a replenished punch-bowl. The fragments cleared away.*)

Gardiner. A gentleman below requests admittance. He sent this card.

Sir Jonah. Scalpel!—Request him to walk up.

Gray. Scalpel!—I've seen some o' his squeebs. 'Feth, he's a clever cretur, Scalpel.—Is na it some kin' o' medical teetle? Belive 'twas him wrote the Nawtomy an' the pe—fe—

Sir Jonah. Hush!—

(*Enter* Scalpel, *ushered by* Gardiner.)

Sir Jonah. Sir, you are welcome. Though I never had the pleasure of meeting you before, I feel as if I had known you all my life. With your writings I have long been familiar; and you must permit me to throw all ceremony aside, and look upon you as an old acquaintauce.

Gray. An' me tae. Sir, you're raal welcome. Gairdner, anither gless.

Scalpel. I thank you. The purpose of my visit, shortly, is this. I heard that you were about to start a Magazine of the Operative Arts; and, as your names carry the assurance that it will be such a work as it will be an honour to be connected with, I wish to offer my services as a contributor.

Sir Jonah. Sir, they will be acceptable.

Montgomery. Yet there is something which will be more acceptable still, and that is your company, which, I trust, we may be favoured with as often as you are not more agreeably occupied.

Scalpel. I promise myself too much pleasure and advantage from your society to permit me to hesitate in accepting your invitation. The establishment of your periodical will constitute an era in the literature of the arts. It will, of course, be the Magazine—being the only one conducted by able, practical, and scientific men.

Gray. Haud, haud—That's a wee censorious. Whatever may be the fauts o' the ither Maggazine folk, it's at least hardly richt to run them doon ahint their backs.

Sir Jonah. It shall not be behind their backs. I have a little bird in the arras yonder, taking note of all that has been said, and it shall be published.

Omnes. Published!!!

Sir Jonah. Why not? Honest men should never say anything that they care to have repeated.

Gray. Ma feth, but that's a braw doctrin'! Verra comfortable to private intercoorse! I reckon ye'd be for exculpatin' that American body they ca' Willis, wha drew folk into confidential conversation, an' published it a' whan he gaed hame?

Sir Jonah. Far from it. I abominate all such unprincipled tattlers, and therefore give you all timely notice of my intention. If vetoed, the thing shall not be done.

Scalpel. For my part, I care not a whit. The babble of wise men is better than the wisdom of fools.

Gray. What! print my stichet sang, an' set the mistress imaegenin' that I gang to see a hizzie they ca' Moripas! Od, et wad be a sair tacket in my shae.

Sir Jonah. Fear not, Alexis; I'll secure you against all unpleasant consequences.

Gray. Weel, on that condition—but ye maun na put intil 't that I knocket owre the caunlesteck—

(*Enter* Garniner.)

Garniner. Supper is ready.

Gray. An' wha div ye think wull read sic nonsense? I dinna ken what we've been talkin' o' the nicht ava.

Sir Jonah. A sensible question. Our talk to-night has certainly been somewhat incoherent, and not very edifying to any one; but the awkwardness of a first appearance will, we are sure, be excused by our readers, when accompanied by the assurance that we shall mend our hand for the time to come.

Scalpel. We must have all subjects of practical interest discussed.

Sir Jonah. Yes: the fact is, we are too literary, and not sufficiently practical in this number; but wait till the next number comes out.———Will you take my arm?

(*Exeunt omnes.*)

Art. VII.—TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

It was our intention to have graced our first number with a review of the last volume of these Transactions; but we find ourselves, in the first place, unable to afford the necessary room; and, secondly, it has been suggested to us, that our review should extend to the two preceding volumes; of which it is contended no adequate review has hitherto been published. We confess we have some doubts whether our labours ought to be so widely retrospective; as well as whether they are, in this instance, as necessary as those most favourably affected towards us pretend: but, upon these points, we trust to be able to make up our minds against our next number. In any case, we shall take an early opportunity of reviewing the last volume of these Transactions; and may not, perhaps, be unwilling to address ourelves to the analysis of the two preceding ones, if able to believe that our labours will be acceptable and advantageous.

Art. VIII.—MOSELEY'S MECHANICS.

The Mechanical Principles of Engineering and Architecture. By the Rev. Henry Moseley, M.A., F.R.S. London: Longman & Co. 1843.

We have in this work the substance of the Lectures delivered by the author, during the last three years, to the students of engineering in King's College. The book itself consists of about 630 closely printed octavo pages, and treats of a great variety of subjects, as might indeed be expected from the author's design, as expressed in the first sentence of the preface.

> "I have proposed to myself to apply the principles of mechanics to the discussion of the most important and obvious of those questions which present themselves in the practice of the engineer and architect; and I have sought to include in that discussion all the circumstances on which the practical solution of such questions may be assumed to depend."

This expression of the author's proposed plan is also a very fair exposition of what the book really is, if we exclude the first 160 pages, which, we can hardly think, fall properly within the scope of the above description of what was intended. The truth of this remark will, we think, be borne out by a very brief summary of the contents.

The work is divided into six sections, or parts. Part I. is a scientific exposition of the leading propositions of the theory of Statics, viz., the composition and resolution of pressures; and the theory of movements and parallel pressures, including a discussion of the principal theorems concerning the centre of gravity.

Part II. is a similar treatise on theoretical Dynamics, commencing with a definition of the term "work," which is here employed to denote the useful effect produced by any machine, and is measured by the pressure overcome, multiplied by the space over which it is moved. We have then a systematic discussion of the various parts of Dynamics, such as the theory of uniform and accelerated motion, pendulums, projectiles, centres of percussion, and oscillation, &c., &c., and the part is wound up with a short but clear exposition of the laws of friction and the rigidity of cordage, so far as they have been ascertained by experiment.

Part III., which only commences at the 160th page, ought, according to the preface, to have been the commencement of the book. All before this is occupied with Mechanics as such, and have no more connexion with engineering than with Astronomy, Navigation, or any other science where mechanical principles are employed. Part III., then, commences the "*application*" of these principles to engineering, and treats of the "Theory of Machines." The Professor evidently considers this as the crack section of his book, and is at considerable pains in establishing its claims to originality, (a valuable distinction in these book-making times.) And whatever may be our opinion as to the establishment of his merits in this respect, he certainly does not mince the matter when laying claim to them. Witness this from the preface: "The greater portion of the subjects discussed in the third part of my work I believe to be *entirely* new to science." To illustrate this comprehensive creed of the Professor's, read the following, taken at random from the table of contents of this third part. "The wheel and axle; a system of one fixed and any number of moveable pulleys; the capstan; dead points in the crank; fly-wheel," &c., &c. What an array is here of subjects that were never before grasped by the hand of science! What an irresistible evidence at once of the Professor's modesty and originality!

But to be serious: we suspect that the Professor, in the sentence we have quoted from the Preface, made a slip, and only meant to say that he had *treated these subjects in a manner* new to science. We can hardly pronounce at this moment authoritatively, whether or not this modified claim ought to be allowed; but we shall explain, in as few words as possible, in what the new method of treating the subject is supposed mainly to consist; and then, if the reader thinks it worth while, he can investigate the claim of originality for himself. Professor Moseley, then, has discovered that the work done by any machine is always less than the work (the "power" is the more general expression,) applied to the machine to give it motion. The difference between the useful effect and the power applied is absorbed in overcoming the friction and other resistances of the machine. The ratio between the power applied and the effect produced varies, of course, in every different machine according to the amount of friction, &c. This ratio, however, can for every different machine be expressed in an algebraic formula founded on the ascertained laws of friction, and this formula or ratio the Professor has dignified with the name of the "modulus" of that machine, and introduced into it the algebraic equation for the work done by the said machine. In this way he has clearly proved that every machine has a "modulus," and has at the same time succeeded in making the formulas for the useful effect of the machines fully six times longer and more complicated than they were wont to be. This, to the best of our judgment, is the cream of the Professor's discoveries.

As we said before, we are unwilling to give judgment off-hand as to their originality; but we are certainly very much disinclined to believe that the discovery of so important a part of all machines as the "modulus" must needs be original, and the consequent mystification of all previously received formulas can be entirely the work of one man—even of Professor Moseley.—But this "modulus" is mystifying us as well as the Professor's formulas, and we are forgetting that we were engaged in giving an account of the contents of the book.

We resume where we left off, at Part IV. This part is to Statics what the last part was to Dynamics, viz., an application of the doctrines of Statics to the theory of a great variety of structures, such as, walls for supporting roofs and retaining water, gothic buttresses, arches, their thrust and equilibrium, &c., &c. We notice one remarkable omission; viz., the absence of the slightest hint on the formation of roofs, whether of wood or iron. This omission is the more remarkable, as the subject is so often treated in merely theoretical works as affording one of the most elegant applications of the doctrines of the resolution and composition of pressures. Perhaps we may account for the deficiency, from the author's evident itching after originality, which might deter him from handling a theme so hackneyed.

Part V. contains a very full theoretical discussion of the strength of materials. An immense variety of cases of strain are considered, both as applied to beams and columns; the best section and longitudinal elevation for cast-iron beams are determined, and various intricate theorems connected with the subject of suspension-bridges are investigated. This section, on the whole, seems very complete; but we would have liked it better if there had been a larger infusion of experimental research, even at the expense of curtailing some parts of the mathematical dissertations.

Part VI. is a short chapter on Impact, as exemplified in the pile-driver.

The volume is then closed with an appendix, containing various useful tables and several notes illustrative of the preceding parts of the book.

The whole of the subjects treated of in the work now before us are discussed entirely in a theoretical manner; that is to say, the powers of each machine and the laws which regulate the proportions requisite to secure stability in each structure are determined exclusively from the principles of theoretical mechanics, without on any occasion calling in the aid of practical examples taken from the numerous works which have already been executed in every department of engineering. Neither have we any information with regard to the materials of which the various works in civil engineering may be constructed; and although there is a very elaborate treatise on the general principles that regulate the strength of wood and cast-iron beams and columns, we have no attempt to apply those principles to the determination of the proper strength of parts in any particular machine. Throughout the work the Professor has made no scruple to employ profusely many branches of the higher mathematics; indeed his treatise would be entirely unintelligible to any reader not previously versed in these studies. We must in justice state, however, that the work is for the most part well written and does much credit to the author's knowledge, skill and research in the department of physico-mathematical science. We have little knowledge of the state of mathematical acquirements among the students of King's College, but if the generality of the engineering students can readily and easily follow the Professor in prelections such as are exhibited in this volume, their mathematical attainments must be of no mean order. We say if they can *readily and easily* follow these prelections, for we doubt not that they learn at least a *smattering* of the differential and integral calculus which would enable most of the demonstrations now before us to be hammered into their heads in some sort of way; but we hope Professor Moseley will agree with us in thinking, that unless they can master them with ease to themselves, they would profit much more by lectures pitched on a lower key, where if the demonstration were not equally general and comprehensive, it would at least be more completely understood and far more readily applicable to practice.

When boys just emancipated from the Latin Grammar are forced to read Horace, the meaning and still more the beauties of the ode are among the last things they think about. Their whole attention is absorbed in the necessary task of finding an English word to correspond with each Latin one. So it is with young engineers newly initiated in the mysteries of the calculus. In making them apply their newly acquired knowledge to the theory of the suspension-bridge, their minds are far too much puzzled with the mechanical business of differentiating and integrating to allow even a fragment of their thoughts to rest on the theory, the elucidation of which is supposed to be the object of all their efforts.

Before dismissing the work now before us, we cannot refrain from noticing what we conceive to be its greatest fault considered as a treatise addressed to young men who are *supposed to be about to apply its principles to practice*; —the fault we allude to is a too great straining after scientific and theoretical perfection, and too general an absence of consideration for the wants of practical men. It is the rendering the formulas and theorems unnecessarily complicated by introducing considerations that tend only to make them appear more perfect to the eye of a mathematician, but which, in place of rendering them more useful to the engineer, will only in nine cases out of ten operate as an effectual bar to his applying them at all.

Our limits will not admit of our going into any analysis of the work generally; but to illustrate and enforce the remark we have just made, we must trouble our readers with a specimen of the Professor's formulæ. Here is one from the Third Part, that is given by the Professor to determine the proportion between the power and the weight raised in the case of the wheel and axle.

$$P_1 = P_2\left(\frac{a_2+E}{a_1}\right)\left\{1+\left(\frac{1}{a_1}+\frac{1}{a_2}\right)\rho \sin.\phi\right\}+\frac{D}{a^1}\left\{1+\left(\frac{1}{a^1}+\frac{1}{a_2}\pm\frac{W}{D}\right)\rho \sin.\phi\right\}$$

Here P_1 is the power applied to the wheel. P_2 the weight raised by the rope passing round the axle; a_1 the radius of the wheel, and a_2 the radius of the axle. ρ is the radius of the journal on which they both turn. D and E and sin. ϕ represent constant quantities connected with the rigidity of the cord or rope and the friction of the journals, which the reader could not properly understand without perusing the author's chapter on these subjects.

Now the usual formula for giving this proportion of the power to the weight raised in the wheel and axle, is simply $P_1 = \frac{P_2 \cdot a_2}{a_1}$ It requires only a glance to see how very much superior in simplicity this is to the professor's improvement of it. But then, this old fashioned formula took no account of the friction, or the loss of power sustained from the stiffness of the rope; its results were therefore always more or less at variance with actual experience: and practical mechanics, who knew nothing about theory, and who did not wish to know anything of it, exclaimed that it was of no use; that it could not tell you what a machine would do; that it only lead all those who trusted to it wrong; and so forth. Professor Moseley being a theoretical man has taken up the gauntlet on the side of theory, and as the best means of vindicating its power and accuracy, has *improved* and extended it. The result of such improvement and extension is very fairly exemplified in the professor's formula, quoted above. We do not deny that the theory of the wheel and axle as there given, is more perfect than as expressed by the shorter formula—that it is now more nearly in accordance with experience; neither do we find fault with the author's efforts to perfect, so far as possible, the theory of machines, or of structures. But we do say, that such efforts as the present tend exclusively to perfect science, not to improve practice, and on this ground they ought to be confined to their proper place, in a professedly scientific treatise, and not marshalled in a work professing to guide and instruct the *Engineer*. We conceive that the author would have much better consulted the interests of his students, if he had given them the simple formula expressive of the power of the machine, supposing that there was no friction or resistance of any kind, and added a few general remarks as to the usual amount of deduction that must be made in practice, on account of those impediments that, for the sake of simplicity, had been omitted in the theory. The system that the professor has adopted has this great disadvantage also; that it *pretends* to give results *exactly conformable* to experience; and that the results of experience may be considered uniform. Now neither of these propositions is true. For, although friction and rigidity of cordage are here taken into account, no notice is taken of the resistance of the atmosphere. This latter source of loss of power is, indeed, not generally much felt in this particular case; but we beg the reader to understand that the observations we are now making, are not meant to apply exclusively, or even principally, to this particular mechanical power, but are intended as so many strictures on the *system* that runs over the greater part of the work, and has in almost every chapter been more or less detrimental to its utility. Of this system, the particular case now before us is taken at random, merely as an example.

To return to the subject,—we say that this neglected item of the resistance of the atmosphere is *very frequently* of great importance—more in amount often than friction and rigidity of cordage together. Where would then be the accuracy of the professor's formulas? In place of securing to the theorist the coveted honour of being the *a priori* expounder of the results of experience, they would draw down on him the ridicule of the comparatively illiterate, who, in proportion to the depth and complexity of the philosopher's theorizing, would be delighted to see so much algebra end in such a surprising degree of inaccuracy.

But, even supposing that it were possible to give formulas more nearly approaching to perfection than those we have now before us, it must appear evident to all that know anything of the actual business of the engineer, that they must either be *very much* simpler and easier of application than most of Professor Moseley's, or they must lie as so much lumber on the office table.

The truth is, that science and scientific attainments are of great, nay indispensable importance, to all who would be really good engineers: but science, when applied aright, will be used by them, not in determining every little minutia of the work they are designing, but in selecting and regulating the *great principles* of its construction, and the proportions of its principal parts. The judicious and scientific engineer will proceed fearlessly on the authority of theory alone, so far as he knows that theory to be well founded, and its applicability to the case in hand, certain. He will there stop, and henceforth use science as a guide in directing him in ascertaining what previous examples of engineering work are such as to form the best pattern for his own; he will still further use science as his safest guide in altering the proportions or arrangement of former works, so as to adapt them in the best manner to the circumstances of his own case; and—let us not scruple to confess it—there will still be innumerable details that must be left to the experience he has gained in the workshop, and to perfect and superintend all, he must call to his aid as large a portion as possible of—"common-sense."

In conclusion, we beg that what we have now said may not be misunderstood as expressions of contempt for, or depreciation of, scientific and mathematical pursuits, even of the most subtle and refined nature. On the contrary, we regard them as alike honourable to their professors, and useful to the community. We conceive them to be the surest means of improving all the arts of civilized life. All we contend for is, that those who write books *for Engineers* should keep their theories to themselves, till they can work out some *practically useful result*, and *then*, they may with propriety produce, for the benefit of the profession, both the practical rule, and the investigation on which it is founded.

Art. IX.—THE STEAMER "TAGUS."

This is perhaps the handsomest steam-vessel afloat, and is certainly one of the best; none has ever been tried more severely, or has more successfully maintained the high character she originally won; and we might fairly stand convicted as apathetic or unprincipled journalists, if, with our sense of this vessel's extraordinary merits, we omitted to bring them fully and fairly before the public. To withhold honourably earned applause is just as criminal as to laud without desert; and although such practitioners as the constructors of this vessel may well be indifferent to our feeble commendation, the insignificance of the offering may be redeemed, perhaps, by its sincerity, and our expositions will be at least acceptable to those desirous of having vessels built, and who stand in need of such information as we are enabled to furnish.

The *Tagus* was built by Messrs. John Scott and Sons, of Greenock, in 1837, and her engines are by Messrs. Scott, Sinclair, and Co., of the same place. Of the engines we propose for the present to say nothing, and shall confine our remarks to the structure of the hull, and the performance of the ship. The following are some of the more important particulars.

DIMENSIONS OF THE "TAGUS," AS PER REGISTER.

	feet.	Register tons.
Length	$182\frac{1}{10}$	497
Breadth	26	
Depth	$17\frac{4}{10}$	
ENGINE ROOM.		
Length	$58\frac{8}{10}$	$285\frac{2}{10}$
		$782\frac{2}{10}$

The following are the builder's dimensions :—

	Feet	inches.	
Length of keel, and rake forward . . .	186	1	709 $\frac{88}{94}$ tons.
Breadth, extreme at shaft, about . . .	28	1	
Depth from deck to ceiling	17	4	

Quarter-deck raised $3\frac{1}{2}$ feet above the main deck.

Keel	American elm, sided 13 in. in middle, moulded 13 in., scarphs 5 feet 6 in., well fastened.
Keelsons . . .	Main one African oak, 15 in. by 16 to 18 in., moulded; four-side keelsons, Quebec oak, sided, 14 in. by 15.
Floorings . . .	In midships, sided 13 in., moulded in seats 14 in.; forward and aft, sided 9 and 10 in.
First Futtocks .	In midships, 11 in.; forward and aft, 9 in.; all these cross the engine and boiler-room, forming floors.
Second Futtocks .	In the heel, 9 to 10 in.; in the head, 9 in.; forward and aft, 9 in.
Third Futtocks .	10 in. and 8 in. forward; and aft, $8\frac{1}{2}$ in.
Top Timbers . .	Sided 8 in. to 6 in.
Frame	Entirely composed of British and African Oak, all properly fitted and chocked. Cant timbers forward and aft bolted in the heel to deadwood. The large siding of the frame extends eighty feet in midships. One hundred and twenty feet in middle of vessel is filled in solid with pine five feet up, and caulked. All this framework well bolted.
Stem	African oak, sided at heel 10 in.; at head, 13 in.
Apron	African oak, in proportion to stem.
Stern-post . . .	African oak, sided at heel 10 in.; at wing transom, 13 to 14 in.
Wing Transom .	British oak, sided 13 to 14 in., moulded to correspond.
Fashion Timbers .	Sided 8 to 9 in.
Room and Space .	In midships, 28 in.; forward and aft, 29 in.
Bottom Plank . .	Garboard strake, American elm, 6 in., cross bolted, and bolted and treenailed up and down; from that to the bilge, one strake 5 in.; rest from 4 to 5 in. Bilge plank, outside, five strakes, three of 6 in., and two of 5 in., American elm; well bolted through $\frac{7}{8}$ in. copper, and clenched on ceiling. From bilge to wales, 4 in., red pine or Memel pine.
Wales	Two lower strake, $4\frac{1}{2}$ in., red pine, and two upper strake, African oak.
Clamps	For upper deck, 4 in., African oak or British oak in midships, and 3 in. at the ends; and for main cabin deck, and fore-cabin deck, two strake African oak, 4 in. in midships, and 3 in. at the ends.
Ceiling	Four strakes on bilge, 4 to 5 in., African oak, in midships, and 3 to 4 in. at ends.
Ceiling on bilge .	Well bolted with copper, and clenched on rings.
Ceiling	Rest of the ceiling 3 in. red pine or Memel pine.
Paddle-beams . .	African oak, 20 to 22 in. by 13 to 14 in.; scarphs dowelled and fastened with screw bolts.
Beams	All the upper deck beams of British and African oak, 11 by 12 in.; the lower deck beams of same materials at hatchways, and pitch pine between. Poop deck beams 8 by 9 in., red pine.
Stringers . . .	For upper deck beams, 4 in., British or African oak, by 12 in. broad.
Knees . . .	British oak, $6\frac{1}{2}$ in. for lower deck, and 6 in. for upper deck.
Iron Knees . . .	Two iron knees to secure paddle-beams, about 5 cwt. each. The engine space is secured with African or British oak diagonals, well bolted, and iron knees to fasten to deck beams where wanted; 2 inch bolts go through the beams fore and aft, secured with large nuts and screws.
Decks	Main deck, 3 inch red pine; quarter-deck, yellow pine, $2\frac{1}{2}$ in.; cabin sole, and fore-cabin deck, $2\frac{1}{2}$ in. yellow pine.
Breast-hooks . .	Four breast-hooks or pointers, all well bolted.
Fastenings . . .	The vessel is treenailed with British oak, pine, and locust treenails, and all bolts under the 14 feet water-mark are of copper of suitable sizes. Butts fastened with a bolt and treenail, and a bolt in second timbers from the butt, through and clenched on ceiling. Engine room beams secured with wooden and iron knees, and diagonals well bolted.

The *Tagus* is very tastefully rigged, and the masts and yards are extremely well proportioned : the following table gives the chief dimensions :—

	Extreme length from Deck.		Length of mast-head.		Length of body.		Diameter at deck.		Diameter at top.		Rake on four feet.	
	feet	in.	feet	in.	feet	in.	feet	in.	feet	in.	feet	in.
Foremast . . .	56	1	9	10	46	3	0	$19\frac{1}{2}$	0	$10\frac{1}{2}$	0	$3\frac{1}{2}$
Mainmast . . .	48	0	8	0	40	0	0	18	0	$9\frac{3}{4}$	0	$4\frac{1}{2}$
Mizenmast . . .	45	9	6	2	39	7	0	$13\frac{1}{4}$	0	$6\frac{3}{4}$	0	$8\frac{3}{4}$

The length of the chimney is 35 feet 2 inches, and the diameter 5 feet 9 inches. The length of the waste steam pipe is 33 feet, and the diameter 12 inches. The fore-yard is 56 feet 6 inches over all, 11 inches in clear at the middle, and $4\frac{3}{8}$ at the extreme ends. The reduced ends of the yard are 3 feet long each, and the diameter at the shoulder 6 inches. The foretop-mast is 44 feet 2 inches over all, $9\frac{3}{4}$ inches in clear at bottom, $3\frac{1}{8}$ inches at top, and $7\frac{1}{2}$ inches in the middle. The maintopmast is 44 feet over all, and the mizentopmast 32 feet 11 inches over all.

The cost of the *Tagus* was £30,182 4*s.* 3*d.*, of which £26,470 was paid to Messrs. Scott and Sons, and Messrs. Scott and Sinclair ; to H. Cameron, for cabin fittings, £1084 6*s.* 5*d.*; to Thomas Ramsay and Co., for sails, cordage, &c., £450 11*s.* 2*d.*; to M'Cunn and Russell, for plumbing, £329 2*s.* 11*d.*; to W. Wardlaw, for painting, £194 2*s.* 6*d.*; to John Fyfe, for ironmongery, &c., £189 0*s.* 1*d.*; and the rest in trivial accounts, including, however, £276 5*s.* 8*d.* for mattresses, blankets, &c.

The symmetry of the *Tagus* is the theme of universal admiration, and she is, we think, the best finished vessel we have ever seen. Her cabin accommodation is extensive, commodiously arranged, and magnificently fitted. It is an extraordinary, but indisputable fact, that cabins are much more tastefully fitted in the Clyde than in any other place whatever. There are, of course, artists of greater proficiency to be found in London than in Glasgow or Greenock, but they do not appear ever to have turned their attention to ship decoration, and those to whom this branch of the art is almost altogether restricted in the Thames, are persons of no taste or ingenuity, and very imperfect powers of execution. The general merits, moreover, of the Clyde decorators are very great, and some of them whom we have met with possess capacities which require only a brighter sun and more auspicious climate to raise them to the stature of successful genius. In the decorations of the *Tagus*, many marks of these high qualities are visible—subdued, it is true, by the urgent haste in which such works have to be produced, and the inadequate emolument they meet with, but the smouldering fire cannot be extinguished by these discouragements, and shines out through every crevice which the hand of a brighter destiny may have opened. Nor are these evidences of an exquisite taste confined to the decorations of this vessel : the lines, proportionment, and general configuration of the ship are full of grace and beauty, such indeed as could only have their origin in a mind of great acquired skill, and great natural sensibility. It is a mistake, we think, to look upon ship-building as a mere mechanic art ; a thorough skill in it is not to be acquired by empirical rules, or mere experience, but it requires for its successful exercise an acuteness of perception, and a delicacy of taste, which can only vegetate in minds of a particular constitution. The fact is, ship-building, in all its higher requisites, is essentially a fine art ; and those only can succeed in it who possess those higher qualifications, and that divinity of soul essential to the enterprises of fancy.

The success and regularity with which the Tagus performs her voyages will best be illustrated by a specific statement. Since Southampton has been her port of departure, she has made twenty-one voyages to Gibraltar, and on every occasion and in all weathers she has been back in Southampton on Saturday morning, between the hours of four and eleven A.M., with the exception of four times, when, from fogs, &c., she was so delayed that she did not arrive until Sunday morning. Sunday is, we believe, the day on which the vessel is only due at Falmouth, so that she has arrived *on every occasion* a day before her time, and on *almost* every occasion two days before it. At Gibraltar, again, she has arrived on every occasion upon the Sunday, except once, when she was detained until the Monday, though still much within the time at which she was due. Regularity such as this is, we believe, unprecedented in the annals of steam voyaging, and, we submit, bears out our original assertion, that this vessel is as efficient as she is handsome.

In repairs, again—that is, in the repairs of the hull—this vessel has absolutely cost nothing, if we except the repair rendered necessary upon one occasion by being run into by another steamer, the Royal William, when a considerable part of her paddle-box and bulwark was carried away. The expense, however, even on this occasion, was trifling, and the damage done quite inconsiderable ; whilst the Royal William, although she came almost direct stem on, sustained a damage which it required an outlay of several thousand pounds, we understand, to remedy. This, perhaps, affords some illustration of the relative strength of the two vessels. The Tagus was comparatively uninjured, while the Royal William had her bow distorted, and almost stove in ; indeed it is stated in the report of the Commissioners appointed by Government to inquire into steam-boat accidents, that the Royal William was so much damaged that she would have sunk immediately, had the rush of water into the vessel not been stopped by her water-tight partitions.

Such are a few of the particulars of this admirable vessel. There has been often an outcry against Clyde-built steamers, and sometimes with reason. for it is not to be supposed that bad vessels may not have been built in the Clyde as well as in every other river ; but the best Clyde-built vessels are equal in strength, durability, and soundness, to the vessels, built in any other place whatever ; and for symmetry, finish, and speed, far surpass all others. From this judgment, however, we except Cowes ; to the high merits of Messrs. White we shall, on some future occasion, pay our humble tribute. The unsoundness of some of the West India mail vessels is made the subject of a tirade against Clyde-built ships ; as if one Clyde builder should be answerable for the demerits of another, or as if some unsubstantial adventurer who happens to pitch his tent in the low grounds of Greenock or Port Glasgow should be accepted as the measure of that character and skill which distinguish their tried and legitimate denizens. Vulgar persons, indeed, in London, talk of the Clyde as if it were one great manufactory, and perhaps really suppose that every ship there produced is the work of the same person; and although we might overlook the blunders of such persons, we can have no tolerance for those who know better, and yet speak and reason in the selfsame strain, with the disingenuous intent of perpetuating the delusion. The fact is, good ships are to be had in the Clyde, and bad ones also, as we suppose is very much the case in every other port; and the established and eminent builders in the Clyde are as jealous of their fame and as loath to do anything by which it might suffer as the eminent builders of any other locality. Many of the ships built by Messrs. Scott and Sons fifty years ago are still plying between Greenock and foreign countries; and those who, while acknowledging the beauty of the Clyde-built vessels, are disposed to question their efficiency, durability, and strength, we would only put in possession of this fact, and refer them for all further evidences to the manifold perfections of the steamer Tagus.

Art. X.—HOLTZAPFFEL ON MECHANICAL MANIPULATION.

Turning and Mechanical Manipulation; intended as a work of general reference and practical instruction on the Lathe, and the various mechanical pursuits followed by Amateurs. By Charles Holtzapffel. London. 1843. pp. 462.

Before opening this volume we had a vague presentiment that we should find it little better than a heap of rubbish: not that we were insensible to Mr. Holtzapffel's abilities as a mechanist, of which on numerous occasions we have had the most ample evidence, but that it appears improbable to us a man immerged in active business should find time to compose a treatise of any great depth or concentration; and would hardly be disposed to incur the penalties of precipitate authorship, but for the hope of drawing attention to his own manufactures. We therefore expected to find little in the volume before us, besides commendatory descriptions of the ingenious playthings manufactured by Messrs. Holtzapffel and Co., with recipes perhaps for turning snuff-boxes, and other articles of similar importance. We doubted whether Mr. Holtzapffel would be very explicit, or very impartial, and had no expectation of obtaining from him any information of the least avail to the serious purposes of practical men. In these anticipations we find we were altogether wrong: we have rarely met with a work manifesting greater intelligence, industry, and skill; or less deformed by egotism and ostentation. Of all the treatises devoted to the elucidation of the various branches of the mechanical arts, we do not believe that any treatise in any language is at all comparable to that of Mr. Holtzapffel, so far at least as we can venture to judge by the present volume; and what is, perhaps, still more surprising, the modesty of the author is quite as eminent as the merit of his performance.

The title of the work we are inclined to find fault with, as we think it calculated to convey a false impression of the scope and objects of a treatise embracing all the mechanical arts, and intended to extend to five volumes. It is not upon turning that Mr. Holtzapffel alone, or even principally treats, and in the whole compass of the volume before us there is scarce a word about turning at all. We therefore think, the title of Mechanical Manipulation, which of course comprehends turning, would have been far better, without any other adjunct. Men naturally raise their eyes in wonder, on hearing of a treatise on turning, in five sizeable octavos; and are apt to conclude that the work must either be intolerably prolix, or can never be completed. Indeed, it may be questioned, whether any one could say enough on turning to fill five octavo volumes worth being said, or at least worthy of being recorded.

The introductory chapter undertakes to point out the importance of the art of turning to our arts and manufactures, and is, we think, the worst part of the volume. It aspires to fine writing, which is manifestly not Mr. Holtzapffel's forte; is written with a degree of labour and constraint, most painfully conspicuous, and, though containing many just observations, often wanders into extravagance and bombast. Our readers may take a few extracts taken almost at random from this part of the work.

> "The art of turning must be admitted to be an auxiliary of great importance in the economy of mankind, as to it we are more or less immediately indebted for nearly all the component parts of the machines and instruments which are conducive in a thousand ways to the support and clothing of the person, and the advancement of the mind.
>
> "How, for instance, could the engines which are now habitually and almost universally employed in converting the numerous raw products of the earth to our most urgent as well as to our most refined pleasures and necessities exist, in the absence of the tools indispensably required for the accurate production of the circular parts, that enter so largely, and in so important a manner, into their respective structures. How, again, without the lathe could we possess another machine in which the circle abounds, namely, the steam engine? which, like an obedient automaton, endowed with power and endurance almost unlimited, is equally subservient either in converting the raw materials into their manufactured products, or in transporting them in either state across the ocean, or over the surface of the earth along with the individuals through whose energies they have been collected, transformed, and distributed."

Now all this has been so often, and so much better said, that we humbly conceive Mr. Holtzapffel would have acted a much wiser part in avoiding altogether such delineations. They provoke dangerous comparisons, and raise expectations, which it requires a brilliant fancy and graceful pencil in any degree to satisfy. Nothing, in fact, can be more ridiculous than mock sublimity, and the following burst is, we fear, removed from it by an almost indefinitely small quantity.

> "How largely also do the circle and its many combinations enter into the elegancies and ornaments of life; more particularly in the useful and indispensable creations of taste and fancy, obtained from the wheel of the manufacturer of pottery and porcelain; and more or less so in all the arts of design and embellishment, whether applied to the useful and agreeable purposes *of ornamenting the costume of nations*, assisting towards the production of the art of engraving, or in that most important of engines, the printing machine, which disseminates in millions of channels the thoughts and speculations of the human mind; throughout all of which the turner's primary element, the circle, is equally pervading and indispensable."

All this is not merely useless and unsubstantial, but very clumsily put together. Though Mr. Holtzapffel's other gifts may be great, he has manifestly not a spark of imagination, and should be careful how he again ventures upon ground where, without such a qualification, he can never be endurable. The whole of the introduction indeed, is heavy, tautological, and not unfrequently preposterous: and we should be very glad to see it obliterated *in toto*. Against any such verdict, it is true, Mr. Holtzapffel has entered an exception in his preface. The work, he says, is a technical one, and he hopes to escape literary criticism; but it is impossible to listen to such pleas when an author stands plainly convicted of literary aspiration. Perhaps, however, it is best, after all, to confess that our strictures upon this part of the work have been sharpened not a little by the goodness of the other portions of it. Critics, like lawyers, live by finding flaws, and have often unfortunately no other way of showing off their attainments, or convincing the public of the importance of their occupation!

Having got over his fit of eloquence, Mr. Holtzapffel proceeds to furnish us with a list of authors who have written on the art of turning, and which, we think, is interesting and appropriate. Plumier, one of the most considerable of these, who flourished at Lyons, about the year 1700, ascribes the invention of turning to Tubal Cain, and conceives that the numerous circular works which adorned Solomon's temple must have been formed in the lathe. This is of course all idle speculation, such, indeed, as might have been expected of a French priest—which it appears Plumier was—of a century and a half ago. The work of Plumier, however, appears to be on the whole a performance of great merit, and in many of his statements he is followed by the Encyclopedists, and other subsequent writers. The chief works on turning in our own language are those of Mr. Ibbetson, and Mr. Rich, of Southampton, but they relate to ornamental turning almost exclusively. The articles, Turning, Lathe, and Rose-engine, in Rees's Cyclopædia are excellent, and a good deal of miscellaneous information on the same subjects is to be found in the treatise on iron and steel, in Lardner's Cyclopedia. The only work on heavy turning, of any authority, we now recollect is, that by Mr. Nasmyth, of Patricroft, in the Appendix to Rennie's edition of Buchanan's Mill-work.

The present volume is devoted to the consideration of the differences, choice, and preparation of materials, and the different modes of working them, without any considerable recourse to cutting tools. This wide field is again subdivided into the three minor cantonments of materials from the vegetable, from the animal, and from the mineral worlds. Under the first of these subdivisions, woods are chiefly spoken of, and there is a vast deal of sound, valuable, and original information given respecting them. This will, perhaps, be best made apparent by a few extracts.

> "The quantity of sap-wood is various in different plants, and the line of division is usually most distinctly marked; in some, as box-wood, the sap is very inconsiderable, and, together with the bark, is on the average only about the thickness of a stout card; whereas in others, as the snake-wood, it constitutes fully two-thirds of the diameter, so that a large tree yields but an inconsiderable stick of wood of one third or fourth the external diameter. It may be presumed that in the same variety of wood about an average number of the layers exist as sap-wood; as in cutting up a number of pieces of the same kind, such as the black Botany Bay-wood and others, it is found that in those measuring about two inches diameter the piece of heart-wood is only about as large as the finger; but in pieces one, two, or three inches larger, the heart-wood is also respectively one, two, or three inches larger, or nearly to the full extent of the increase of the diameter. The sap-wood may be therefore in general considered as of about an average thickness in each kind of wood; it is mostly softer, lighter, more even in colour, and more disposed to decay than the heart-wood, which proves it to be in a less matured or useful state."

It is generally from the existence of sap-wood in the timbers of a ship that the dry rot first arises, and this predisposition in the sap-wood to decay will be much heightened if the wood has been used while wet and unseasoned, and afterwards kept in a damp state, without any current of air to carry off its own exhalations. A very small portion of sap-wood may be the means of infecting a whole ship with dry rot, and that formidable ailment may indeed arise without the presence of sap-wood at all; but generally speaking, where it attacks other than very old vessels, all the concurrent causes have been in activity. The most powerful of these is, in our judgment, want of proper ventilation.

The drying of woods effectually is an object of much importance, especially for the finer purposes of the arts, and may be facilitated by artificial heat. But heat alone will be ineffectual, unless conjoined with a current of air, which will carry away the moisture exhaled by the wood. Heated rooms in which a current of air is artificially maintained, have been found very effectual.

The hardness of woods is very nearly proportional to their specific gravity. For some purposes the specific gravity of the lighter kinds is increased by mechanical compression: trenails for ships and for railway purposes have been treated in this manner, and the practice is found to be a great improvement. At one time the compression was accomplished by passing a cylinder of wood of the required size through rollers, and then cutting it into the proper lengths; but this plan was found to flatten the fibres of the timber; and the method now adopted is to force the trenails through an iron ring, which compresses them on all sides equally.

The descriptive catalogue of woods, extending from page 71 to page 116, is a work of great labour and worth. We regret that our limits prevent us from giving as many specimens of it as we could wish, but we will give some.

> "ACACIA, true. The *Acacia Proxima Mordi*, A. Guillard's MSS., called in Cuba *Sabicu*, and in England *Savieo* and *Savacu*, is a heavy durable wood of the red mahogany character, but rather darker and plainer; it is highly esteemed in ship-building. In the Admiralty Museum, leaves, &c., of the tree are to be seen, and also specimens of the original timbers of the 'Gibraltar' of eighty guns, launched in 1751, some of the wood of which is now in such perfect condition that Sir W. Symonds intends to use the old keel of the Gibraltar (made of Savico) for that of a new frigate.
>
> "BEECH. Only one kind *(fagus sylvatica)* is common to Europe; in England the Buckinghamshire and Sussex beech are esteemed the best. It is used for piles in wet foundations, but not for building; it is excellent, from its uniform texture and closeness, for in-door works, as the frames of machines, common bedsteads, and furniture; it is also much used for planes, tools, lathe-chucks, the keys and cogs of machinery, shoe-lasts, pattens, toys, brushes, handles, &c. The carved moulds for the composition ornaments of picture frames and pastry, the large woodcu types for printing, are also made of beech: the wood is often attacked by worms. Beech is stained to imitate rosewood and ebony, and it is considered to be the most chemically free from foreign matters: for example, the glass-blowers use the wood almost exclusively in *welding*, or fusing on the handles of glass jugs, which process fails when the smallest portion of sulphur, &c. is present; oak is next in estimation for the purpose.
>
> "BOX-WOOD *(Buxus sempervirens)* is distinguished as Turkey and European box-wood. The former is imported from Constantinople, Smyrna, and the Black Sea, in logs felled with the hatchet that measure from two to six feet long, and two and a half to fourteen inches diameter. The wood is yellow, inclining to orange; it has a thin rind, with numerous small knots and wens: some of it is much twisted, and such pieces do not stand well when worked; on the whole, however, it is an excellent, sound, and useful wood. Box-wood is much used for clarionets, flutes, and a great variety of turned works; it makes excellent chucks, and is selected by the wood-engraver, to the exclusion of all other woods."

The articles "BLACK BOTANY BAY-WOOD," (called also African Black-wood,) and EBONY, are very interesting, but too long for us to extract. The first of these woods comes to us in knotty and crooked billets, covered with a thick rind, of the colour and consistency of box-wood. When fresh cut it is of a bluish black, with dark grey streaks, but soon changes to a jet black. The stone-masons of the countries from whence it is imported use splinters of it for making lines upon their work, and the mark is not easily washed off by the rain. This wood is excellent for turning, being, perhaps, the hardest of all woods, and susceptible of a fine polish; but it is so full of shakes, irregularities of growth, and other imperfections, that it is difficult to get a sound piece of any size. There is still some uncertainty as to the locality where the wood grows: the greatest quantity, however, appears to be brought from the Mauritius, to which place it is sent from the interior of Madagascar. The tree appears to have a scrawling serpentine growth, like the vine.

Of Ebony there are three sorts; of which the best comes from the Mauritius in long poles; the next best from Madras and Bombay in logs and planks; and the worst from the Cape of Good Hope in billets. Ebony is used for a great variety of purposes in the arts, as for cabinet, mosaic, and turnery works; also for flutes, the handles of doors, the handles of knives, &c. Piano-forte keys are generally made of the East Indian variety.

LIGNUM-VITÆ, or *Guaiacum*, is a hard and heavy wood, much used for rollers, sheaves of ships' blocks, skittle-balls, pestles and mortars, and a variety of other purposes. When first cut it is soft and easily worked, but soon becomes hard by exposure to the air, apparently by the induration of the large quantity of gum-resin it contains. Lignum-vitæ is brought chiefly from Cuba, Jamaica, St. Domingo, and New Providence. It appears to be indigenous on the Isthmus of Darien, and forms there one of the most abundant woods of the country.

We must endeavour to find room for a part of what Mr. Holtzapffel says about Teak.

> "TEAK-WOOD is the produce of the *Tectona Grandis*, a native of the mountainous parts of the Malabar coast and of the Rajahmundry Circars, as well as of Java, Ceylon, and the Moulmein and Tenasserim coasts. The teak-wood, when fresh, has an agreeable odour, something like rose-wood, and an oil is obtained from it. The finest now produced comes from Moulmein and other parts of Burmah. Some of this timber is unusually heavy and close-grained; but in purchasing large quantities care must be taken that the wood has not been tapped for its oil, which is a frequent custom of the natives, and renders the wood less durable."

One of the most curious articles of vegetable growth we have met with is the Ivory-nut which is produced abundantly in Columbia and the adjacent districts. The nut is solid, with the exception of a small central cavity, and is composed of a substance which nearly resembles ivory. The common size is about two inches diameter. The central cavity limits the application of this extraordinary nut to insignificant purposes, such as knobs for umbrellas and walking sticks. Some of the nuts, we believe, are to be seen at the Polytechnic Institution.

The extended use of timber in the arts is restrained chiefly by its perishable and combustible qualities, and it has always been esteemed an object of great importance to counteract its disposition to rot quickly or be easily burned. Kyan's Anti-Dry-Rot Patent is well known in this country, and has been extensively, and, we believe, successfully used; but the preparation of timber by this plan is tedious and expensive; so much so, indeed, as to limit its applicability to the most particular and costly works. Dr. Boucherie, a Frenchman, has however devised a mode of making all kinds of wood extremely durable and incombustible, at a very trifling expense. It consists in introducing chemical liquids into the trunk of the live tree, which speedily become diffused through the minutest pores of the wood, and give it entirely new properties. The pyrolignite of iron introduced in this manner prevents every species of rot, and makes the wood much harder: the earthy chlorides, in like manner, make the wood almost incombustible. By introducing odoriferous essences, any desired scent may be given to the wood; and by introducing dyes, any desired colour. Deliquescent salts, if introduced, will, by keeping a certain degree of moisture in the pores, preserve the elasticity of the wood, and prevent it from warping and splitting. The chemical liquids may be introduced to the tree after it has been cut down, by enclosing them in a leathern bag, which is made to encircle the stem; but the best plan appears to be to bore a hole through the standing tree a little above the ground, and run a wide saw-cut from the centre towards each side, leaving enough wood uncut to maintain the tree in its position; the proper liquids may then be introduced, a trough of clay or other suitable substance being made all round the tree, to retain the liquid in the cut.

Of the materials enumerated by Mr. Holtzapffel as derived from the animal kingdom for the purposes of the arts, the most important is ivory, of which there are two varieties, the African and Asiatic, the former being the more esteemed. To these may be added the fossil ivory of Siberia, much used in Russia, and which consists of the tusks of the mammoth. The ivory of the hippopotamus is much harder and whiter than common ivory, and is more than double the price; it is almost monopolized by the dentists, for making artificial teeth. Ivory veneers have latterly been made of a great size, by cutting a cylinder of ivory spirally, and unrolling it out.

The materials from the mineral kingdom are much more numerous than those from either the vegetable or animal ones. The description of the modes of working the harder stones and the gems given by Mr. Holtzapffel is highly interesting, and displays great ability and research. The chapter on forging iron and steel is also very good, though some of the expositions will, we fear, appear trite to some readers. The same remark applies to the chapters on foundry operations. We do not find that Mr. Holtzapffel has given any examples of the larger and more difficult loam castings; such, for example, as the sole plate and condenser of a marine steam-engine; he has given cylinders, and other things of that nature, but in them there is comparatively little difficulty. To this, however, he may with reason answer that such heavy works are less in the way of the amateur. The chapters on works in sheet metal and soldering are admirable; it is, indeed, in describing these lighter works that Mr. Holtzapffel chiefly excels. With the manipulations of the engineer, millwright, and engine-founder, he is apparently less familiar; but with us the wonder is that any one man should be capable of becoming so intimately acquainted with operations so numerous and so dissimilar.

We have already greatly exceeded the bounds to which we intended to limit these remarks when we set out, and cannot extend them farther; yet we feel we are taking leave of Mr. Holtzapffel rather abruptly; and, indeed, his book deserves a more extended analysis than it is in our power to give. We know of no book on the same subject of equal goodness; and although our acquaintance with ingenious mechanics is not a narrow one, we have never met with a more accomplished mechanist than Mr. Holtzapffel, or one whose accomplishments sit more gracefully upon him.

ART. XI.—THE COTTON MANUFACTURE.

The Hand Book of Silk, Cotton, and Woollen Manufactures. By W. COOKE TAYLOR, LL.D. London: Bentley. 1843. pp. 211.

This is a cheap, well written, and very frivolous volume; out of the twelve chapters into which the work is divided there is scarce a word illustrative of the actual condition of our manufactures or of the mechanisms employed in them, except in the last four chapters, and the most of the information we meet with there is trite and valueless. The great bulk of the work, indeed, is devoted to a history of the processes of weaving and spinning from the creation to the present time; and the most laudable impartiality is shown in awarding to each generation the same superficies of print, without any reference to the trivial condition whether the said generation produced anything worth recording. The improvements of the last century, which constitute, in fact, the only part of the subject which ordinary readers will look upon as important, are thus necessarily compressed into a very limited compass; and the rest of the work is devoted to such speculations as whether the fig-leaves of our first parents were not connected together by twisting the stems, instead of being *sewn* together, as our translation of Genesis inaccurately renders it; whether Abraham brought Hagar out of Egypt on account of her skill in spinning; and whether, inasmuch as Rahab the harlot of Jericho concealed the spies of Joshua under the stalks of flax, spinning did not at that time flourish in Palestine. We have also a great deal about the skill of Helen in embroidery, and about the strength of Samson and treachery of Delilah; the coat of Joseph, which it is insinuated was of *Scottish tartan*, and the golden net with which Vulcan captured his faithless spouse and her paramour. Goddesses and prophets, poets, warriors, and weavers dance through every page in the most giddy and fantastic array; and sacred personages and events are exhibited in a ludicrous light by this improper intermingling, and associations are in danger of being called up, subversive of that solemn awe with which the sacred records should ever be contemplated.

We do not by any means maintain that the ancient history of the textile fabrics may not be very interesting, or that Mr. Taylor has not in many instances made us feel how interesting it may be rendered; but we think such inquiries are neither so useful nor so attractive as many of those Mr. Taylor has excluded, and are more suited to a scholastic dissertation than to a popular treatise on an art which, in its really important features, is of very recent origin, and which is so fertile in devices of consummate ingenuity and commanding interest and importance. The literary merits of the work are not inconsiderable, though even this praise must be taken with many important exceptions. The views propounded in reference to free trade are in our opinion just, and are often expressed very felicitously; but, upon the whole, the work exhibits no great judgment, and no great acquaintance with the subject; it is tiresome, superficial, and pedantic, and will, we fear, never become a great favourite with the public. It is time, however, that we should give our readers a more exact account of its contents, which we are afraid few of them have had virtue enough to ascertain for themselves.

The first chapter is devoted to the "Early History of Spinning and Weaving." It begins, of course, with the creation, and ends with Julius Cæsar, and affords, we think, a fair specimen of the solemn trifling and exuberant erudition of which we have complained. Every thing in which the word "spinning," "weaving," or "flax" once occurs, whether in sacred or profane history, is deposited in these pages without scruple; and the result is a heap of heavy and heterogeneous rubbish, which few, we believe, will have the assiduity to work through. The author perpetually appears to our optics as if he had just brought off a back-load of learning from the Bloomsbury mine, and was anxious to set it down in the first possible place in order to relieve himself from the oppression of the burden. The fittest place, therefore, is seldom selected, nor is the question apparently once broached, whether so much book learning will be of any good at all; but page after page is diligently filled in, and any chasms in the work are grouted with poetical quotations, which for this purpose come in very appositely. In the anterior parts of the volume there is scarce a page which does not contain a considerable intermixture of poetry, and some contain more poetry than prose.

The art of weaving, Mr. Taylor informs us, preceded that of spinning, rushes and strips of the bark of trees being probably formed into fabrics before spinning was found out; and this was no doubt the kind of manufacture practised in the garden of Eden in the case of the fig-leaves, inasmuch as Eve cannot be supposed to have had sewing-needles of the modern description. Flax, we learn, was cultivated in the land of Egypt in the times of the Mosaic plagues; and we find from the book of Exodus, that "all the women that were wise-hearted did spin with their hands." Spinning among the Egyptians was a domestic occupation, and the term "spinster" is still applied to unmarried ladies. But the spindles of ladies in ancient times were highly ornamented, which reminds us of the present Alcandra made to Helen of a pot of purple wool. This last important event is duly confirmed by a poetical quotation.

Spinning and weaving were also practised in Idumea, as appears from the book of Job, in a passage containing the same image as in Hezekiah's complaint. The history of Samson shows that the Philistines were considerable weavers, and Homer incidentally mentions the spindle in his description of a race. Ovid tells us how Minerva mauled Arachne with a shuttle; and this is proved by the following delectable verses, which we extract:—

> "A boxen shuttle in her hand she took,
> And more than once Arachne's forehead *struck*.
> The unhappy maid, impatient of the wrong,
> *Down from a beam her injured person hung*."

We had almost forgotten to mention the important fact quoted from Exodus, that "all the women whose hearts stirred them up in wisdom spun goat's hair."

Moses' method of making gold threads appears to have consisted in beating the gold into thin plates, cutting it into strips, and rounding them on the anvil; and *Vulcan*, according to Homer's account, formed his wires in the self-same manner. The dress of Pharaoh's daughter appears to have been a net-work of a very fine mesh, and the dress of Cleopatra, as described by Lucan, shows that she had very skilful milliners. The finer fabrics were called by the Hebrews שבץ *shebetz;* and this species of clothing appears to be referred to in the 45th Psalm, of which Psalm we are therefore favoured with part of an improved translation.

Such are the chief contents of chapter the first, omitting, however, the numerous poetical quotations, which we must honestly confess we have not read; at least, none of the long ones: and we think our readers will concur in our judgment, that it consists chiefly of idle and ostentatious speculation,—such, indeed, as might be expected of a weak and ambitious academician. Such a patchwork of sacred and profane history—exhibited, too, as if it were all equally credible—is not merely very useless, but very irreverent; and even if exempt from this fault, would be greatly out of place in a popular treatise upon a mechanical art. We fear, moreover, that Mr. Taylor's *taste* is not much more eminent than his judgment; a verdict no one, we believe, will question, after reading the following passage:—

> "Had Solomon resembled some modern statesmen he would have protected the spinning industry of Judea by laying a prohibitory duty on the import of foreign yarns; but Solomon was aware that the protection to Hebrew flax-growers and spinners would so enhance the price of yarn to Hebrew weavers, that they could not bring their goods into a foreign market. He did not establish a monoply, for he saw very clearly that every monoply is a great injury to the many for the smal benefit of the few, and instead of telling his weavers to look exclusively to the home-market, he endeavoured to open for them as many foreign markets as possible."

Chapter II. is devoted to an exposition of the "Early Progress and Extension of Spinning and Weaving," and begins by telling us that "in the age of Joshua weaving establishments were found in the land of Shinar, and most probably in the chief city of that district, ancient Babylon. A mantle of Shinar, *or, as our translators have rendered it*, 'a Babylonish garment,' was secreted by Achan from the spoils of Jericho. The carpets of Babylon were celebrated in very ancient times, and Homer reckons a carpet among the luxuries with which Menelaus astonished Telemachus. Ezekiel speaks favourably of the Tyrian manufacturers; and when Hecuba resolved to make a rich offering to Minerva, she sent her a veil of Sidon. The following is no improvement, we think, upon Pope:—

> "Freighted, it seems, with toys of every sort,
> A ship of Sidon anchor'd in our port;
> What time it chanced the palace entertain'd,
> Skill'd in rich works, a woman of their land."
> *Odyssey* xv.

The following, from Theocritus, is *hardly* equal to the original:—

> "Gracious! how delicately fine
> The work! how noble the design!
> How true, how happy is the draught!
> The figures seem inform'd with thought—
> No artist sure the story wove—
> They 're real men,—they live, they move.
> From these amazing works we find
> How great, how wise the human mind!
> Lo! stretch'd upon a silver bed,
> (Scarce has the down his cheeks o'erspread)
> Adonis lies! O charming show!
> Loved by the sable powers below!"

The third chapter is on "Spinning and Weaving in Greece and Rome," and consists chiefly of translations of Virgil and Ovid into bad rhyme. It winds up with Gray's Ode, beginning,—

> "Now the storm begins to lower,
> Haste, the loom of hell prepare," &c.

which, of course, makes the spinning accomplishments of the Greeks and Romans plain to the meanest capacity.

In chapter IV., "On the early History of the Textile Arts in Britain," the poetical effusions begin to diminish considerably, and their place is supplied by an old Irish legend about one Walloty Trot, a sort of fairy, we presume, who produced excellent yarn. Chapter V., on the "Special History of the Silk Manufacture," exhibits a marked improvement. And chapter VI., on the "Special History of the Cotton Manufacture," is very good. From the commencement of this chapter we must make an extract:—

> "The history of the cotton manufacture in England is without a parallel in the annals of any age or country. In the beginning of the reign of George III., it gave employment to forty thousand persons, and the value of the goods produced was 600,000*l.*; it now employs not less than fifteen hundred thousand persons, and the value of the goods produced exceeds 31,000,000*l.* It is difficult to form a conception of the extent of such a manufacture; but the following calculations may help our readers to an intelligible idea of its vastness. The cotton yarn annually spun in England would, in a single thread, girdle the globe 203,775 times; it would reach fifty-one times from the earth to the sun; and it would encircle the earth's orbit eight times and a half. The wrought fabrics of cotton exported in one year would girdle the equatorial circumference of the globe eleven times. The cotton manufacture furnishes one half of British exports, employs one-eleventh of our population, and supplies almost every nation in the world with some part of its clothing. The receipts of the merchants and manufacturers from this single branch of industry, equal two-thirds of the public revenue of the kingdom.
>
> "The folly of the opposition to machinery was never so forcibly displayed as in the history of the cotton trade; at this moment, when machines have been invented which enable one man to produce as much yarn as three hundred men could have produced at the accession of George III.—which enable one man and one boy to print as many goods as a hundred men and a hundred boys could have produced then—when steam-engines perform the work of 33,000 horses, and

water-mills of 11,000 horses—so far is manual labour from being superseded, that the number of operatives has increased from forty thousand to one million and a half. Nor has this increase been accompanied by diminution of comfort to the families of the operatives;—the amount paid in wages among the whole of the old operatives (40,000 in number) was but 220,000*l.*,—that is, little more than 2*s.* a week each. Let this state of things be compared with the following estimate of the annual expenditure for cotton manufacture, which was made in the year 1838.

			VALUE.
Consumption of Cotton in	1838		£19,604,166
Wages paid—			
Operatives in spinning factories	,,		8,659,593
Power-loom weavers	,,		2,946,000
In bobbinet and hosiery trade	,,		1,650,000
Printers	,,		9,360,000
Hand-loom weavers, 280,000, 12*s.* gross	,,		8,596,000
Replacing machinery, 8 years taken at the rate of increased capital		4,312,500	
Interest on increased capital, £62,000,000		3,100,000	
Add for all other charges, oil, gas, flour, clerks, counting-houses, &c. &c. say		4,000,000	
9000 capitalists or masters, at wages, chief workmen, say 75*l.* per annum, yearly		675,000	
			12,087,500
Yearly Expenditure			£62,903,259

Chapter VII., on the "Early History of the Cotton Manufacture in England," is readable; and chapter VIII., descriptive of the "Era of Invention," is still better. The "mechanical processes of spinning and weaving" are described in chapters IX. and X., and in a way very suitable for a popular treatise, though they contain no information respecting those processes which every one is not in possession of who has given any attention to the subject. The following episode on labour is good :—

"Labour, like every thing else that comes into the market, has its price regulated by the ratio between demand and supply. Now, if there be any species of labour requiring but a small exertion of skill and strength, the supply in that branch of industry will be mainly derived from the unskilful and the weak, whose competition will of course bring down the wages of those who may possess greater knowledge and power, but who have entered on a trade in which there is no demand for these qualities, or at least for such an amount of them as many operatives engaged in that branch of industry may be supposed to possess. In general we find, that the rate of wages in any employment is regulated by the amount paid to the lowest rate of qualifications adequate to the performance of the task. If the same piece of work can be equally well executed by an ordinary man and an ordinary child; it is far more likely that the man will be reduced to the child's wages, than that the child will be raised to the man's wages. The hand-loom-weaving of plain goods is an employment which requires so low an amount of qualifications, that a number of Irish labourers, disappointed of obtaining employment in reaping the harvest, turned to the hand-loom, and with scarcely any training, were found adequate to working the machine. We have ourselves seen persons working at the hand-loom, whose debility would have incapacitated them from obtaining employment in almost any other branch of industry. In the neighbourhood of Burnley and Colne, we saw children working at these looms, and it is therefore clear that such competition must have brought down the rate of wages, even if the power-loom had never been invented.

"If one manufacturer employed men paying them men's wages, he would soon be driven out of the market by another manufacturer who employed children and paid only children's wages. If all the manufacturers of England combined to employ men only, it would only be a stimulus to the employers of children in the other countries of Europe and America. The home-market even now is insufficient for the absorption of the goods produced, and the foreign market must be closed as soon as foreigners are able to undersell us. In fact, it would be impossible to retain possession even of the home-market, for the foreign goods, if not regularly imported, would assuredly be smuggled in, and the hand-loom weavers would thus only exchange insufficient support for absolute starvation."

The account of the process of singeing yarn may perhaps be new to some of our readers :—

"The yarn designed for making bobbin-net lace and the finer species of hosiery, is subjected to another process called gassing, which is in fact the singeing off of the loose fibres, or any other unevenness of the thread, by a flame of gas, through each of which the thread passes several times with a velocity proportioned to the number of the yarn. The machinery is set in motion by the winding and unwinding of bobbins, each of which revolves from 2000 to 3500 times per minute. Each thread passes through a cleaner slit in a lever, and when a knot or rough point occurs too large to pass through the slit, the whole mechanism for singeing and winding that thread is thrown out of gear by the jerk given to the lever. The attention of the gasser or tenter of the machine, who is generally a female, being thus directed to the defect, an instant remedy is applied without stopping the action of the rest of the machinery."

The XIth chapter, on "Bleaching," &c., contains nothing, we believe, that has not been said again and again upon the same subject. The following, however, is a compendious account of the bleaching *curriculum* ;—

"The washing does not remove all the gluten and oil which the cloth received when it was subjected to the dressing process by the weaver; for this purpose it must be boiled in lime. The boiler has a false bottom perforated with holes, over which the cloth is laid in alternate layers with cream of lime. A stream of boiling water jets from a pipe in the upper part of the boiler over the layers, and sinks through them into the part below the false bottom; here, as it is again heated to the boiling point, it is forced up through a pipe in the middle of the boiler, and again spouted over the cloth. This process is usually continued for eight hours, when, the paste-dressing, grease, etc., being effectually removed, it is once more washed in the dash-wheel.

"In the next process the cloth is steeped in a weak solution of sulphuric acid, which forms a sulphate of lime with the lime of the former operation. After this it goes back to the dash-wheel. It is next boiled in a weak solution of carbonate of soda, to remove any oil or grease left by the lime, and again washed by the dash-wheel.

"The cloth is now ready to be subjected to the action of the bleaching fluid, that is, chloride of lime dissolved in water. About a gallon and a half of this liquid is allowed for every pound-weight of cloth, and about one pound of bleaching powder for two pounds of cloth. In this mixture the goods are steeped for about six hours; when they are taken out, they appear sufficiently bleached to an unpractised eye, especially after they receive another washing in the dash-wheel. But the experienced eye soon discovers that the colouring matter of the fibre is not yet completely removed.

"Again the cloth is steeped in a weak solution of sulphuric acid, the mixture having one gallon of acid for every twenty-five gallons of water. The chlorine disengaged during this operation would render the process unwholesome without care and vigilance, but it is conducted with such caution that all danger is averted. In this process, the oxide of iron which may have been deposited on the cloth is removed, and the lime disengaged from the chlorine forms sulphate of lime with the acid. Sulphate of lime being, in fact, soft alabaster, is capable of being applied to ornamental purposes; we have seen some pretty toys at Mr. Thompson's great works at Primrose, near Clitheroe, made from the sulphate which had been deposited on the sides of the vats.

"After having been washed, the cloth is again boiled in a solution of carbonate of soda; then washed, and passed through a weaker bleaching fluid than was first used; washed again, and a third time passed through the solution of sulphuric acid. The bleaching process is now complete, and the cloth receives its last washing previous to its being dried."

The observations on dyeing and calico printing are derived chiefly from the Encyclopædia Britannica, and are destitute of any high interest; we hasten, therefore, to give our readers a specimen of the concluding chapter, on the "Factory System;" which is by far the best, we think, in the book, and hardly appears to be the work of the same individual.

"A question often asked by the ignorant and unthinking deserves some portion of our consideration; they ask, whether the demand for labour would not be greatly increased if the operations of machinery were suspended, and hand-labour employed to produce the present amount of fabrics? The plain answer is, that in such a case, nothing like the same amount of fabrics would be produced in England, for their price would not remunerate the manufacturer, even though he should pay his workmen the lowest possible rate of wages. The English hand-spinners of cotton could never compete with the Hindoos in the production of fine yarn; with the Egyptian Fellahs in the manufacture of coarse threads; with the African negroes in common products of the loom; or with the Indians of North America in cheap articles of dress. English artizans would starve on the same rate of wages, which would support life in a country less heavily taxed, and no higher rate of wages could they obtain so long as there existed one foreign competitor to meet them in the market. It is a great, but a neglected truth, that machinery sustains wages; for it is by means of machinery that so large an amount of spun and woven fabrics is produced; it is in consequence of the magnitude of this amount that British manufactures can be sold so cheap; and it is in consequence of their superior cheapness that these articles find purchasers. The sad example of the hand-loom weavers, to which we have already referred, shows the utter inability of British artizans to sustain competition with the foreigners when they are not backed by the support of machinery."

The following is, in our eyes, exceedingly just, and highly eloquent :—

"The factory system is a modern creation; history throws no light on its nature, for it has scarcely begun to recognise its existence; the philosophy of the schools supplies very imperfect help for estimating its results, because an innovating power of such immense force could never have been anticipated. The steam-engine had no precedent, the spinning-jenny is without ancestry, the mule and the power-loom entered on no prepared heritage: they sprang into sudden existence like Minerva from the brain of Jupiter, passing so rapidly through their stage of infancy, that they had taken their position in the world, and firmly established themselves before there was time to prepare a place for their reception. These potent novelties also made their appearance in a land already crowded with institutions: the force and rapidity with which they developed themselves dislocated all the existing machinery of society, disturbed its very framework, and must necessarily produce, as they have produced, a considerable amount of confusion and suffering until the difficult task of re-adjustment is completed. A giant forcing his way into a densely-wedged crowd extends pain and disturbance to its remotest extremity: the individuals he pushes aside push others in their turn, though none know the cause of pressure save those with whom the intruder is immediately in contact; and thus, also, the factory system causes its presence to be felt in districts where no manufactures are established; all classes are pressed to make room for the stranger, and all are interested in knowing something of what is thus forced upon their acquaintance. Antecedent to any inquiry, it would be well to recognise the factory system as what statesmen call *un fait accompli;* it exists, and must continue to exist; it is not practicable, even if it were desirable to get rid of it; millions of human beings depend upon the factories for their daily bread,—were there heads sufficiently bold,

> and hearts sufficiently hard, to propose their extermination, where are the hands by which the sanguinary decree could be executed?
>
> "It would be absurd to speak of factories as mere abstractions, and consider them apart from the manufacturing population. That population is a stern reality, and cannot be neglected with impunity. As a stranger passes through the masses of human beings which have been accumulated round the mills and print-works in Manchester and the neighbouring towns, he cannot contemplate these 'crowded hives' without feelings of anxiety and apprehension almost amounting to dismay. The population, like the system to which it belongs, is NEW; but it is hourly increasing in breadth and strength. It is an aggregate of masses, our conceptions of which clothe themselves in terms that express something portentous and fearful. We speak not of them indeed as of sudden convulsions, tempestuous seas, or furious hurricanes, but as of the slow rising and gradual swelling of an ocean which must, at some future and no distant time, bear all the elements of society aloft upon its bosom, and float them—Heaven knows whither. There are mighty energies slumbering in those masses. Had our ancestors witnessed the assemblage of such a multitude as is poured forth every evening from the mills of Union-street, Magistrates would have assembled, special constables would have been sworn, the Riot Act read, the military called out, and most probably some fatal collision would have taken place. The crowd now scarcely attracts the notice of a passing policeman, but it is, nevertheless, a crowd, and therefore susceptible of the passions which may animate a multitude."

The following we look upon as over-painted; and it involves, we conceive, a portentous fallacy:—

> "To talk of infant labour is sheer nonsense, and nothing else. What master would be insane enough to employ an infant or a child incapable of performing the task for which he pays wages? If mill-owners and capitalists were worse tyrants than Nero, still they would not be such fools as to throw away their money for the mere indulgence of sportive cruelty. There can be no question about the labour of infants, but there must be many questions about the labour of boys and girls, so long as operatives have families and feel the necessity of supporting them. That legislative protection should be extended to the children nobody means to deny; but the protection is wanting, not against their employers, but against the extremes to which griping poverty in most instances, and grasping avarice in some, may drive their parents.
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> "It has pleased some people to portray the mill-owners as the living representatives of the ogres and giants of our nursery tales. They are simply men, not one whit better or worse than their neighbours; their chief characteristic is a very acute sense of their own interests, and those interests forbid them to be tyrants. 'Tread on a worm,' says the old proverb, 'and it will turn:' but tread on a Lancashire operative, or his children either, and you will find yourself more awkwardly situated than if you had provoked the hostility of all the worms in existence. The extremity is not likely to be tried by those who have millions of property at the mercy of a rusty nail or the ashes of a tobacco-pipe. Besides, if it were true that cruelties are practised on children in the mills, or that tasks are imposed upon them injurious to health or life, such a fact would only prove that the physical or moral destitution of the parents must be of the most frightful kind, or else they would never, for the sake of trifling wages, expose their offspring to such sufferings.
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> "But we are gravely told, that 'juvenile labour, under all circumstances, is a grievance.' Let us grant it—there is one still worse, and that is juvenile starvation. We have seen, with more pain, the little pieceners and cleaners employed in their monotonous routine, when the sun was high in heaven, when the skies looked smilingly upon the earth, and earth answered with its own smile of loveliness and fertility; I thought how much more delightful would have been the gambol of the free limbs on the hill-side, the inhaling of the fresh breeze, the sight of the green mead, with its spangles of buttercups and daisies, the song of the bird, and the humming of the bee! But we have seen other sights: we have seen children perishing from sheer hunger in the mud-hovel, or in the ditch by the way-side, where a few sods and withered boughs had formed a hut, compared with which a wigwam were a palace. We have seen the juvenile mendicant, and the juvenile vagrant, with famine in their cheeks, and despair in their hearts. We have seen the juvenile delinquent, his conscience seared by misery, his moral nature destroyed by suffering, his intellectual powers trained to perversity by the irresistible force of the circumstances that surrounded him. It is a sad confession to make, but owing, perhaps, to some peculiar obliquity of intellect or hardness of heart,—we would rather see boys and girls earning the means of support in the mill than starving by the road-side, shivering on the pavement, or even conveyed in an omnibus to Bridewell."

It seems to be here taken for granted that there is no possible alternative between work and vagrancy. We wonder how artizans managed to support their children before factories were established, or how they still manage to do so in those districts where there are no factories. If the operatives of cotton-mills earn insufficient wages to enable them to let their children go to school, the obvious remedy is to so raise their wages as to enable them to do so. Against this there would be, of course, the objection that, to raise the wages of the operatives would be to drive us out of the foreign markets; and certainly, to prevent this, we must either improve our machinery, or lessen the price of subsistence. We look up to the prevalence of *constant* juvenile labour as a direct loss to the country, both in happiness and wealth. The growth of many a genius is thus repressed, which, if unfolded by education, might have worked mighty improvement, and contributed to raise his country to a higher pitch of elevation by new resources of ingenuity. We do not, indeed, believe that ingenuity is the creation of instruction; but, without education, ingenuity has nothing wherewith to work; and the greatest talents may be frittered away in a contest with insuperable difficulty, or in wandering among dark and sinuous passages, which lead to nothing. We would not, indeed, desire to prevent juvenile labour *in toto;* but children should only spend so much of their time in factories as will leave them the power of obtaining instruction and recreation; and this we think should not be left optional with the parents; for where a number of persons unite in following a bad practice, all moral feelings of its turpitude is speedily extinguished.

The following we look upon as a piece of idle declamation:—

> "The question must also be regarded in another point of view. The operative has, as we have said, a very limited supply of domestic accommodations; and if his children were excluded from the mills, it is not quite clear what would become of them. Their homes could not contain them, even if they were disposed to remain in them—their only resource would be the street, with all its perils, and all its temptations. Juvenile labour may be a very bad thing; but juvenile vagrancy and juvenile delinquency are infinitely worse. The children will not starve if they can help it; and if food is not to be procured by work, they must either beg or steal."

We here close our extracts, and recapitulate our judgments. Mr. Taylor's talents are, we think, considerable, but of a coarse description. His information is, we fear, rather extended than profound; and though apparently a practised, and in some respects an able writer, he is not, to our taste, a pleasing one. With considerable imagination, his sensibilities are weak and torpid, and he is therefore deficient in the less obtrusive graces of composition, and fond of glitter and parade. The display of such qualities as these are, it is true, altogether foreign to a work on the cotton manufacture, yet they are displayed with evident premeditation; and the work, indeed, is only to be looked upon as a merely literary production. These are serious vices; but a greater still is the pedantry with which this gentleman is so seriously tinctured, and which would be fatal to the success of even greater gifts. If this be a specimen of these *Hand Books*, we fear they will be a failure. Among so many vigorous competitors, popularity is not to be won upon easy terms; and demands something of higher qualifications than the fluent delivery of trivial speculations, or the oppressive erudition of an ascetic academician.

ART. XII.—STEAM WITHOUT SMOKE.

1. *Steam without Smoke; or, Danger from Explosion.* By ROBERT ARMSTRONG. London: Weale. 1842.
2. *The Combustion of Coal, and the Prevention of Smoke chemically and practically considered.* By C. W. WILLIAMS. London: Simpkin and Marshall. 1841. 8vo. pp. 158.

MR. ARMSTRONG, the author of the first of these essays, is already very favourably known to the public as the author of a valuable treatise on steam-boilers; and the intimate acquaintance he has already displayed with the economy of boiler and furnace operations, adds the force of authority to his present exposition. Mr. Williams also has long passed his noviciate as an author, and if unencumbered with fame, is at least rich in notoriety. He has with much ingenuity converted the truisms of chemistry into a vehicle for advertising his patent argand; and whatever opinion we may form of the virtue of his specific, we must at least acknowledge that he has urged it into notice with the most laudable perseverance. In some of our larger manufacturing towns this furnace has, it is said, been extensively adopted; and although Mr. Armstrong informs us that in many cases it has proved a failure, we are bound to believe, from so considerable an adoption, that in other cases it has operated satisfactorily. We are sensible, indeed, of the wonders which advertisement and agitation will accomplish in inducing the trial of even the most preposterous projects, and must confess ourselves unacquainted with any case in which Mr. Williams's plan has been kept in prolonged operation; yet we do not think it could have been kept in operation for even a short period, if its merits had not been such as at least to entitle it to a preference over many of the smoke-burning schemes which have been already before the public. At the same time we are not insensible to the weight of Mr. Armstrong's disapprobation. Mr. Williams is obviously interested in lauding the plan beyond its merits; but Mr. Armstrong can hardly be conceived interested in unjustly disparaging it. He is not a rival patentee, nor does he possess any visible motive to influence his judgment; and we must confess that the unfavourable verdict of so skilful and unbiassed an observer goes far to overset Mr. Williams's pretensions, and to destroy every vestige of confidence in the efficacy of his devices. It is right, however, to examine the subject a little more in detail.

The smoke evolved by every species of bituminous coal, when burned in common furnaces, must necessarily detract considerably from the calorific efficacy of the fire, both on account of the direct loss of a portion of the combustible which passes off in the form of smoke, and is dissipated in the atmosphere, as well as from the loss of the heat requisite to convert the hydrocarbons, so dissipated, into the gaseous form. Numerous attempts have been made to obviate or diminish these sources of waste, by admitting into the flue or furnace a stream of air, to accomplish the combustion of the inflammable parts of the smoke; but the difficulty of apportioning the quantity of air admitted, to the varying wants of the fire, has been found an insuperable objection in the case of ordinary furnaces; whilst the refrigeratory effect of the excess of air it is necessary to admit, in order to bring the atoms of the combustible and the supporter within the range of combining attraction, goes far to neutralize the increased heating power consequent on their combination. In experiments upon smoke-burning furnaces, conducted with great care and skill, a saving of f[illegible] to 14 per cent. has been repeatedly realized; but with the measure of care and skill which furnaces can obtain in the ordinary routine, smoke-burning has invariably been productive of a diminished efficiency or an increased consumption.

All this Mr. Williams acknowledges; but maintains that his is not a smoke-burning, but a smoke-preventing furnace. Smoke, he admits, cannot be burned advantageously; but it is not smoke, he says, but gas, that he attempts to consume. The difference is certainly conceivable, and not unimportant; yet, on looking at the construction of Mr. Williams's furnace, we find that the furnace proper differs in no respect from common furnaces; and the aëriform matter which passes through the furnace-throat must, therefore, necessarily be of the usual description. The whole of Mr. Williams's plan, indeed, consists in letting air into the flue by a multitude of holes; but the substance to which the air is admitted is identical with that in furnaces of the ordinary kind; and his furnace is, therefore, just as much a smoke-generating furnace as any furnace whatever. The difference between smoke and gas is simply this: one is the product of imperfect or incomplete combustion, whilst the other is not the product of combustion at all, but of volatilization merely; and, as combustion is carried on in this gentleman's furnace, the substances flowing past the diffusion-orifices, which are the product of that combustion, cannot be coal-gas by any possibility. The question really at issue is not whether it is beneficial to admit air to gas in one hole or in many holes, but whether, in the case of this furnace, it is gas at all to which the air is admitted. To pretend that smoke can be turned into gas, by letting in air upon it by one hundred holes instead of by one or two, is just as preposterous as to maintain that the plant which, when watered with a common watering-pot, is a lily, will be turned into a thistle if watered with a jug. In spite, then, of all the indignation Mr. Williams has heaped upon "smoke-burning pretenders," it is, in our eyes, undeniable that he is himself one of the genus he so loudly condemns; and as we participate to a certain extent in his disapproval of smoke-burning expedients, we are compelled to surrender him to his own reprobation.

The ineffectual and injurious character of Mr. Williams's arrangements are, we think, very ably pointed out in a report of Mr. Armstrong's, addressed to a respectable manufacturing firm in Manchester, and inserted in the work before us. From this report we shall make a copious extract, for the edification of such of our readers as may not have seen the original document.

"In accordance with your request, I have carefully examined into the circumstances attending the injury sustained by your steam engine boiler, during the three days' trial of Mr. C. W. Williams's smoke-consuming furnace, and have to report thereon as follows:—

"2. Some of the plates in the boiler bottom behind the bridge appear to have been exposed to considerable degrees of expansion and contraction alternately, arising from frequent alternations of temperature, by which means the rivets have been dragged successively in opposite directions until they have become loosened in the rivet holes, and the boiler has become leaky.

"3. One plate is what is usually called 'burnt out,' which is what generally happens when one side of an iron plate is frequently and suddenly heated and cooled, while the other side, from its contact with the water in the boiler, is kept at a moderately uniform temperature. In this case, also, owing to the necessarily laminated structure of wrought iron, combined with the heating and cooling process above described, a 'blister' has arisen in one of the plates, and this blister has been the immediate cause of the giving way of the boiler, by so far weakening it as to allow the pressure of the steam and water to force down the plate in that particular place.

"4. The main cause of the above results is clearly to be traced to the imperfect construction of the furnace, inasmuch as the passage for the admission of fresh air to the flame behind the bridge, is unprovided with a valve or other means of regulating the quantity of air so admitted, or the time of its admission, within the reach of the engineer whilst engaged in firing the boiler.

"5. To enable me to explain this point more fully to your satisfaction, I may state that this mode of preventing, or (as it is most commonly called) burning the smoke, by admitting atmospheric air at or behind the bridge of the furnace, has been long known and frequently practised in Manchester, since it was first generally introduced here by Mr. Wakefield more than twenty years ago. This gentleman also practised the method of *diffusing* the air through several small apertures inside the furnace chamber, in the same manner as Mr. Williams. But in all Mr. Wakefield's furnaces, as well as those of Mr. Parkes, that I ever saw, the passage through which the air was allowed to communicate with those apertures, was supplied with a regulating valve, for the purpose of admitting the proper quantity of air, suitable to the varying state of the fire, or to shut it off at the discretion of the engineer or fireman. And the uniform practice of all operative engineers has always been, when no flame was passing from the fire, and consequently no smoke being made, to shut the air off entirely.

"6. In your case, however, the furnace is so arranged, that a constant large stream of cold air is uniformly rushing into the main furnace chamber, or flame-bed of the boiler, *at all times*, and whether there is a flame passing over the bridge or not. The certain and inevitable consequences of this state of things are, that every time the fresh coal is thrown on the fire, and a flame is produced sufficient to reach through the throat of the furnace, the current of fresh air passing directly into the flame from below, drives the latter right up against the boiler bottom in the manner of a blow pipe, causing it to impinge with peculiar intensity against that portion of the boiler bottom immediately exposed in the direction of the blast. On the other hand, as soon as the fire on the grate has burnt bright, and the flame does not extend over the bridge, the cold air striking against the same part of the boiler bottom which had just been before so unduly *expanded* by intense heat, a sudden contraction of the metal necessarily ensues, besides a great waste of fuel, and difficulty in keeping up the steam."

In answer to this statement, Mr. Williams contends that when there is no smoke to be burned, there is carbonic oxide, and that therefore a rush of cold air through the diffusion orifices, at any time is impossible. But if the furnace be made to produce carbonic oxide in considerable quantity at all so as to combine with the oxygen when there is no smoke, this carbonic oxide must pass off unconsumed, where there is smoke, provided the smoke be consumed, and a great waste of fuel must thereby be occasioned. In the case of ordinary furnaces, it appears impossible indeed for Mr. Williams to extricate himself from this dilemma; he must either have a current of cold air rushing at times through the diffusion orifices, cooling and injuring the boiler, or large quantities of carbonic oxide continually escaping into the chimney, so as to occasion a material waste of fuel. On the whole, it appears to us that although this project may be capable of affording some satisfaction so long as it meets with the care due to a novel and nurseling project—as, indeed, a host of previous schemes have repeatedly done—yet that in the aggregate of ordinary working, it will approve itself troublesome, expensive, and pernicious.

Of Mr. Williams's book, our verdict, we fear, must be as unfavourable as of his invention; yet it has received high praise in various quarters; and although its admirers are not the best sort of admirers, we doubt not their panegyric has been accepted by Mr. Williams as good sterling praise, and will probably render distasteful any more discriminating analysis. Indeed, the expectations of any author who has once tasted of popular applause, are by no means easily satisfied. Upon his first appearance before the tribunal of public opinion, he will generally be content if he escape without censure; but his expectations rise with his success, and the judgment he would at first have accepted with joy and gratitude, he will speedily come to look upon as prejudiced and disparaging. Upon any person, indeed, prominently before the public, a word of disapprobation falls with prodigiously increased weight: so long as he remains in obscurity, reproof is unattended with disgrace because it is necessarily unwitnessed, but the crowd he brings around him by his triumph, if it adds to the brilliancy of success, fearfully aggravates the penalties of failure. Every voice which swelled the measure of his fame will add to the ignominy of his degradation; and a measure of praise which would have exceeded the hopes of his earlier ambition will now only suggest humiliating ideas of his unfitness for the position he has so incautiously usurped, and the derision and disappointment his incapacity has excited.

An inquiry into the phenomena attendant upon the combustion of coal divides itself into two parts. First, The determination of the chemical constitution of the coal; and, Second, The determination of the quantity of air requisite for the combustion of its constituents. Mr. Williams has gone into both of these subjects at considerable length. He has given us a compilation of authorities showing what the chemical composition of different species of coal is, and has favoured us with several chapters and a multitude of diagrams to point out that carbon and hydrogen combine with oxygen in definite proportions. In the whole of these most ingeniously constructed chapters, there is not a single remark of the least worth or moment; and in the whole length and breadth of the book there is nothing new, except its errors and the magisterial solemnity with which the most trite and insignificant truths are reproduced and paraded. Indeed, Mr. Williams seems very fond of burning his gas in the blaze of noon-day. He devotes pages to prove self-evident propositions, and takes infinite pains to convince sceptics of things nobody ever thinks of doubting. He continually speaks of atoms as if he himself had found them out, and as if an introduction to so difficult a theme inspired extraordinary trepidation; as in page 40, for example, where he encouragingly tell us "*not to feel alarmed* at this introduction to elementary atoms and chemical equivalents." In pages 27, *et seq.*, the discovery is announced to us, that when fresh coal is thrown upon a fire, the fire is afterwards not quite so hot as before; in pages 28 and 29, we are assured that heat is necessary to expel gas from coals; in page 35, that a combustible as well as a supporter are indispensable to combustion; and in page 37, that the combustion of gas is accomplished, "not by its combination with the air, as is the vulgar and dangerous notion, but with the oxygen of the air—the supporter of flame—the heat-giving constituent of the air." In page 91, we are told, "Without sufficient time, nothing short of a miracle could satisfy the required extent of diffusion. Nature, however, does not operate by miracles, but by defined laws and progressive means;" and in page 129, we are assured that combustion cannot take place without air; "that providing heat is not providing air, neither is decomposition combustion." In page 11, we are told that Sir Humphrey Davy was an eminent man; in page 20, that Dr. Faraday is the first electrician of the day; and in page 41, that John Dalton is a writer of merit. At page 70 commences a chapter of 30 pages for the purpose of pointing out that as it is oxygen which supports the combustion in a furnace, the air supplied to the furnace must not have been deprived of its oxygen previously, else it will not do:—for thus wisely and thus learnedly argues this philosopher, "If oxygen be not present in the air, how can it otherwise be obtained? How can we effect a union with a thing which is not?"

In extenuation of the marvellous superficiality of this gentleman's treatise, it may, perhaps, be urged that he wrote not for scientific, but for practical men. This argument might, perhaps, have some weight if by practical men were meant our working boiler smiths and bricklayers, who for the most part are supposed to know as much of chemistry as of the Œlic reduplication ; yet, even in this case, we do not altogether see how those persons should be induced to read this book more readily than some of the numerous chemical works to which they already have access. Mr. Williams, however, informs us that he does not address himself to so unpromising an auditory, but to those by whom engineering works are directed and designed. 'Are then our bricklayers or boiler-makers to become chemists? No. But those who direct—those who assume the charge of teaching them to construct the numerous descriptious of furnaces with which this country abounds, should be masters of the leading principles on which their art is based, and the success of their operation depends,' of which it would appear they at present know nothing. Thus in page 2, Mr. Williams informs us, that, even the most experienced engineers know very little about the boiler—in page 3, that in the construction of boilers engineers are without any fixed principles to guide them—in page 4, that he has watched the efforts of engineers to arrive at some degree of certainty, and that he has perceived the absence of any intelligible or well-founded principle in the boiler—in page 5, that instead of improvement there has been latterly retrogression, and that well-established houses even yet know very little of the principles of perfect combustion, or of the economy of fuel. From these and numerous other passages, which might be cited, it would appear to be this gentleman's doctrine that engineers are a very ignorant and stupid race of persons; that though living in England in the nineteenth century they are unacquainted with the simplest and most familiar truths of chemistry; and while possessing the reputation of producing those miracles of ingenuity which carry their fame to the verge of civilization, that they exist in a state of mental stupor which the most besotted Turk could scarcely hope to emulate. A person, indeed, who derived his only information on this subject from Mr. Charles Wye Williams, might imagine our mechanists to be the descendants of some barbarian horde on whom a hereditary curse rested, dooming them to an eternal degradation; who remained rude and untutored even in the centre of civilization, and whom the flame of science could neither melt nor quicken, nor the lessons of experience instruct. It is not astonishing, therefore, that Mr. Williams should speak with much confidence and coolness of the absurdities of the practice of our engineers, which in pages 34, 72, 73, 74, 127, and, indeed, in almost every page throughout the volume, he most industriously exposes. He takes especial care to make manifest the shallowness of Tredgold, and the erroneous notions of Watt, which he of course contrasts with his own higher skill and superior illumination, and finding himself unable to refute what they do say, wisely confines his refutation to what they do not say. In page 134, he states, 'the erroneous view of the combustion of the gases began with Watt;' but after handling poor Watt very severely for his manifold shortcomings, he kindly winds up in the following patronizing strain:—'But let justice, however, be done to Watt. It is not his fault that the errors he committed should continue to be repeated,' which our present engineers are, it appears, wrong-headed enough to do. The following epithets are therefore unsparingly applied to the practice of those obdurate persons; 'erroneous,' 'lamentably erroneous,' 'neglect of chemistry,' 'notable instance of neglect of chemistry,' 'abortive attempts,' 'great practical and chemical error,' 'palpable oversights,' 'unsound principles,' 'chemical blunder,' 'utterly at variance with chemical propriety,' and a host of other equally decorous and appropriate expressions. The secret of all this we suppose is, that Mr. Williams plumes himself not a little upon the smattering of chemistry he appears to have acquired, and in the simplicity of his heart imagines that because our leading engineers do not think it consistent with their dignity to become lecturing itinerants, or to be eternally flashing their attainments in the eyes of ignorant spectators, they know nothing of the most familiar scientific truths, and pay no regard to them in their practice. If Mr. Williams could only see himself as he is seen by others—if he could only perceive the ridicule he draws upon himself, by harping everlastingly about chemical principles, and chemical blunders—and which we can assure him raises the secret laughter of even the most favourably affected—he would, we are sure, gladly retire into the obscurity for which Providence manifestly designed him, and leave the contention for distinction to those who have something better to offer than a flood of empty scientific jargon, or the pitiful pedantry of a boiling empiric.

Since writing the foregoing, we have received a pamphlet on "The Combustion of Smoke in Steam Boiler and other Furnaces, by Charles J. Smith, Liverpool." The doctrines of the author are for the most part identical with those we have enunciated. Mr. Smith manifestly understands his subject well, and expresses himself in very graceful and perspicuous language. We regret that our extracts from this essay must necessarily be very brief; it is well worthy of the attentive perusal of all interested in the subject.

"Most practical men are of opinion that the introduction of cold air into any part of the furnace or flues is injurious. In Parkes's plan, and in many others, cold air has been admitted at the bridge; but though found, when carefully regulated, to consume the smoke, and economise fuel to a certain extent, yet in the hands of a careless or unskilful fireman it was productive of most injurious effects. For, if air be admitted into the flues so as to combine with and cause the combustion of the whole of the gaseous matters evolved immediately after a fresh charge of fuel, it is evident that an immense body of flame will be produced, and consequently the bottom of the boiler and flues exposed to it will be intensely heated. But if the same quantity of air, and especially cold air, be admitted after the hydrogenous portion of the coal has been consumed, and when little else but carbonic acid and oxide nitrogen, and steam are passing over the bridge, it is evident that the boiler bottom and flues must be greatly cooled down; the draught will consequently be injured, and the steam will get low. Beside this, we know that when iron plates are frequently heated and cooled, or when the opposite sides are exposed to unequal and varying temperatures, the laminæ of the metal are apt to separate and rise in blisters, which weaken the boiler to such an extent that violent explosions have frequently been the consequence."

This is perfectly corroborative of Mr. Armstrong's statement, though perhaps a little over-painted. We have learned, however, through another channel, that some more boilers have been damaged by Mr. Williams's plan in precisely the same manner as that to which Mr. Armstrong's report refers. Speaking of the diffusion of the air Mr. Smith says: "This Mr. Williams seeks to accomplish by admitting the air through a great number of small orifices, *which, in fact, constitutes the principal, if not the only distinctive feature of the patent argand smoke preventive furnace.*" And again:—"In concluding these remarks upon the smoke-preventing treatise, and patent Argand smoke-preventing furnace, it may be stated that the latter is no more a *smoke-preventing* furnace than scores of others which have been brought before the public with more humble pretensions as *smoke-burning* furnaces, and for this simple reason: when this furnace is first fed, smoke is generated by imperfect combustion over almost every inch of its area, *just as in any other ordinary furnace.* At the 37th page of his treatise Mr. Williams says, 'One of my objects is to show how the combustion of the volatile products of the coal may be effected as completely when issuing from the throat of a furnace, as from the beak of a gas-burner,' forgetting all the while that the hydro-carbon gases which issue from the gas-burner have been carefully purified from every matter that would impede combustion, and are consequently much more highly inflammable than the heterogeneous mixture of combustible and non-bustible matters which have to be dealt with at the throat of the furnace. This oversight seems to have been the cause of the great mistake, and the foundation on which the non-combustion smoke-preventing theory has been founded."

All this appears to us satisfactory and irresistible, but there is one error into which we think Mr. Smith has been betrayed, apparently by taking some of his facts from Mr. Williams. He says that the plans of Rodda, Drew, and others are unscientific because they pretend to burn smoke without air; but such is not the case, they only pretend to burn the inflammable parts of the smoke *with the air already in the furnace.* In all ordinary furnaces a good deal of uncombined oxygen escapes through the fire; the quantity may be increased almost indefinitely by making the draught strong, and the fire thin; and Messrs. Drew and others only use this oxygen for burning the smoke—diffused and hot as it must necessarily be—instead of letting a stream of cold air into the furnace, and employing a riddle to diffuse it. We agree with Mr. Smith in thinking that many plans exist by which smoke may be obviated, and that the laws against smoky chimneys ought to be put in force. His essay is, we think, calculated to extirpate several vigorous errors, and to put the question upon its true basis; it is highly creditable to his talents, and we hope to have more of his acquaintance.

Art. XIII.—THE ANATOMY OF THE STEAM ENGINE, No. 1.

Under this, and the succeeding head, we propose furnishing our readers with a succession of papers illustrative of the construction and action of the more important varieties of the steam engine. In our choice of examples, we do not engage to be regulated by any very distinct or positive rules. We shall, however, be much guided by the importance of the subjects to be discussed, the comparative deficiency of information or correct theory in more regular treatises, and, perhaps, principally, by our own convenience or caprice, or rather, we should say, by our own necessities; for they who must, like us, supply the periodical demands of the printer from the produce of moments snatched with difficulty from the cares of a life of business or labour, must often write rather what they can on the spur of the moment, than what they would. In these circumstances, it will not be expected that our expositions should have any very intimate or methodical connexion with each other; but in each, however limited may be the point discussed, we will endeavour to make the discussion full and satisfactory. It will be our object, rather, fully to explain a principle, or exemplify in detail the method of applying it to one or two particulars, than superficially apply it to a great variety.

We do not aim at making our illustrations constitute a scientific treatise on the steam-engine, as that would require time, information, and attainments greater than those of which we can boast; but we hope that whatever topics are discussed, will be handled in a scientific manner. In short, while we disclaim for our dissertations, in the aggregate, the most remote pretensions to a systematic treatise on the steam-engine, we are anxious to render each chapter worthy of forming a part, however small, of such a whole.

In the practical part of the subject, we shall give minute and accurate accounts of a few of the best or worst, or most peculiar engines, rather than generalde scriptions of a great number of those of medium quality, and which differ but little from one another; and our explanations will be accompanied or followed by critiques, illustrative of the excellences and defects of particular modes of construction. In the more occult or theoretical part, we shall rather seek to explain *principles*, than inculcate rules, and we do this not from any disregard of the importance, or even necessity, of practical rules in all the pursuits of trade, but because we have always been of opinion that he who thoroughly understands the *principles* will always be most judicious and expert in applying the *rules* that flow from them. While we grant the equal importance of principles and rules to practical men, we have chosen, while not overlooking the latter, to confine our attention in the mean time more particularly to the former, because they, by the natural connexion between the two, hold the first rank, and farther and principally because both engineers and the more regular treatises on the steam-engine are generally most defective in this department.

Having premised thus much on our hopes and our pretensions, we now proceed to introduce to our readers the marine engine, (plates 1 and 2,) which we look upon as well worthy of their notice. The following references will explain to those less skilled in such subjects the names and functions of the several parts.

A, the cylinder; B, the condenser, cast in one piece with the sole plate; C, the air-pump; D, the hotwell; E, the waste water-pipe; F, the cylinder jacket; F 2, a blind nozzle for the extraction of the jacket core; F 3, nozzle to which the steam-pipe is attached; G expansion valve; HH, cylinder ports; I I, short D valves connected with three rods KK; L, cylinder cover; M, cylinder cover stuffing-box; N, stuffing-box gland; O, plug at bottom of cylinder, to permit boring-bar to pass through secured in its place by four keys, and jointed with rust all round at *a*; VC, valve casing; P, valve casing cover; Q, gland of VC cover stuffing-box; EE, EE, eduction passages; R, diaphragm in condenser, to prevent the injection water from running into the lower cylinder port; S, injection pipe, with a shield *s*, to prevent any of the injection water from spouting over the diaphragm; T, cast-iron pipe, for enclosing the main centre; U, the main centre; V, condenser door; W, foot valve; W′, delivery valve; X, door of foot valve; X′, door of delivery valve; Y, screw for pressing down foot valve door; Z, shifting valve.

1, piston; II, II, junk ring; III, III, metallic packing; 2, piston rod; 3, cross head; 4, side rods; 5, side levers; 6, butts of cross tail; 7, cross tail; 8, connecting rod; 9, crank pin; 10, crank; 11, paddle shaft; 11′, intermediate shaft; 12, eccentric rod; 13, expansion valve rod; 14, radius rods of parallel motion; 15, parallel motion shaft; 16, side rod of parallel motion; 17, valve motion shaft; 18, valve lever; 19, valve links; 20, valve rod; 21, valve guide rods; 22, back balance rods and levers, the weights themselves working in the holes T′T′; 23, air-pump guide rods; 24, eyes, fitted with stuffing-boxes, and attached to the air-pump cross head for the rods to work through.

1′, air-pump bucket; II′,II′, junk ring; III′,III′, hemp packing; IV′, pot lid bucket valve; V′, copper lining of the air-pump; VI′, brass casing of the air-pump rod; 2′, air-pump rod; 3′, air-pump cross head; 4′, air-pump side-rods; L′, air-pump cover; M′, air-pump cover stuffing-box; N′, air-pump cover stuffing-box gland.

A′, little cylinder for working the great D valve in starting; 1″, little cylinder piston; 2″, piston rod; 3″, cross head; 4″, side rods; 14″, radius rods of parallel motion; 15″, parallel motion shaft; 16″, parallel motion side rod; 20″, valve rod; *x*, small wiper and two pulleys for moving valve; H″H″, cylinder ports; L″, cylinder cover; M″, cylinder cover stuffing-box; N″, stuffing-box gland; O′, plug for boring bar; I′, slide valve; *y*, eduction passage; *z*, steam passage; P″, valve casing cover; *b*, rust joint beneath cylinder, to prevent leakage into the lower eduction passage EE; *c*, rust faucet joint round circular part of valve casing; *dd*, blocks for squeezing up valve packings; *ee*, lead joints on valve packing doors; *f*, projecting snug, to prevent the D valve from falling down into the bottom of the eduction passage when disconnected from the straps above; *ff*, projecting snugs, to prevent the air-pump from sinking too low in the faucet on the sole-plate; *g*, lapped lead joint of foot valve cover; *h*, lapped lead joint of delivery valve cover; *i*, foot valve seat, cast iron, faced with brass; *k*, lapped lead joint of condenser door; *l*, rust faucet joint round air-pump, the pump being fixed in its place by steel keys, in addition to the steadiment it derives from the bolts in the joint *m*, between the mouth of the air-pump and the hotwell; *n*, delivery valve seat, cast iron, faced with brass; *o*, rust joint between shifting valve chest and bottom of air-pump; *p p*, faucet rust joint round hotwell; *q*, faucet rust joint, between hotwell and air vessel; *rr*, faucet rust joint round little cylinder and valve casing.

It would be premature on the present occasion to indulge in any critical remarks on this engine. We shall reserve what we have to say on this subject until we have laid some additional examples before our readers.

ART. XIV. PHYSIOLOGY OF THE STEAM ENGINE.

No. I.—SLIDE VALVES.

THE use of the common slide-valve, wrought by an eccentric on the fly-wheel shaft, is so general in all kinds of steam-engines, that it is highly important the engineer and artizan should be familiar with the principles on which it acts, and be furnished with plain rules for determining the proportions that should be given to the lead, cover, length of stroke, &c., of the valve, so as to produce any requisite degree of expansion in the cylinder. In almost all books on the steam-engine, the general principles on which the valve and eccentric work, are explained; and we therefore presume that, so far, every intelligent mechanic is already acquainted with them. We shall not, therefore, in this paper encroach on the territory of more regular treatises, by repeating what many of them have already discussed, nor seek to illustrate topics already sufficiently familiar.

Our present object is merely to present, by way of supplement to other works on the subject, a few observations and rules, which we have not elsewhere met with, but which we have found of very frequent utility to ourselves.

We shall first find a formula which—the dimensions of the valve, eccentric, &c., being given—will enable us to find the exact position of the valve, corresponding to any given part of the stroke of the piston; and then a formula to give conversely the position of the piston corresponding to any given position of the valve. We shall then find another formula to determine the cover and length of stroke of the valve that are requisite to cut the steam off at any given part of the stroke. These formulas we shall illustrate by examples, and subjoin a digest of the whole in three practical rules, with examples for the use of those who are not familiar with algebraic notation.

We shall suppose Figure 2, plate 4, to represent a steam-engine cylinder, crank, and short slide valve. A A is the cylinder, v v the valve, a a' the steam ports, e the exhausting port. H S is the valve rod connected with the lever O S, which works on a shaft whose centre is at O. On the same shaft is another lever, O P, to which the eccentric connecting-rod is attached by a pin at P. C is the centre of the fly-wheel shaft, C D the length of the crank, and C V the radius[*] of the eccentric. R D represents the connecting-rod when the piston is at the top of the stroke. p p is the piston, and R p' is the piston-rod. The valve, as shown in dotted lines, is at its middle position, or half stroke. When the piston is at the top of its stroke, however, the valve must be in the position shown by the sectioned lines. The space F E′ which the valve overlaps the steam port, we call the cover on the steam side. L K, the overlap on the other side of the port, we call the cover on the exhausting side. It is usual to have the valve so adjusted that the steam port may be slightly open when the piston is at the top or bottom of its stroke. The space thus open, F E, we call the lead. In adjusting the length of the valve-rod P V, care must be taken that the length is such that when the eccentric is in the position C Q, at right angles to C P, the valve may be exactly in its middle position; that is, that the overlap F E′ may be the same as the overlap G H at the other side. When the length of the valve-rod is thus determined, the proper position of the eccentric on the shaft may then be ascertained by placing the crank in the perpendicular position, as shown in the figures, and turning the eccentric round into a position C V, such that the valve will be pushed downwards so far as to cause the port a just to begin to be opened at F E. The eccentric may then be fixed firm to the shaft.

To facilitate the following investigations, we shall denote the various parts by different letters thus,—

r = radius of the crank.
[†] r' = radius of eccentric, or half the stroke of the valve.
s = distance of the piston at any moment from the top of its stroke.
s' = distance of the valve at the corresponding time from top of *its* stroke.
x = arc travelled over by the crank (measuring from the perpendicular position C D) while the piston has moved over a space $= s$.
c = cover of the valve on the steam side.
c' = cover of the valve on the exhausting side.
l = lead of the valve.

We are now prepared to investigate a formula to give the value of s' at any part of the stroke.

We shall, in what follows, suppose the valve-rod P V, and the connecting-rod, to be both indefinitely long, in comparison with the length of their respective cranks C V and C D; or, in other words, we shall consider these rods to be always parallel to the lines C P and C p'. This, of course, can never be exactly true; but in almost every case the error thus introduced is small in amount, or at least of such a kind as to produce no error in the results[‡] of any practical importance.

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[*] "Radius of the eccentric." Every one who has given the least degree of consideration to the working of the eccentric, knows that it produces exactly the same motion as a small crank whose radius is equal to the distance between the centre of the eccentric ring and the centre of the shaft. In this paper, therefore, we shall speak of the eccentric as if it were in reality such a small crank. Thus the expression above, "radius of the eccentric," means the length of this crank; and so, when we talk of the *position* of the eccentric, we mean the position of this imaginary crank.

[†] It may be as well to observe that the levers that work the valve are, in the figure, supposed to be equal, and of course the stroke of the valve is just double the radius of the eccentric. When the levers are unequal, this will no longer be the case; but in using the formulas that follow, r' must be taken as half the stroke of the valve, no matter what the radius of the eccentric may be.

[‡] It may be satisfactory to the reader that we should make a few remarks, to show how it is that the errors thus introduced into our investigations are of no practical importance. First, with regard to the shortness of the connecting-rod, the error introduced by it arises from the circumstance that the crank is not hori-

When the crank is in any position C D′, the distance s will evidently be equal to D′ U′; that is to r — cos x, and this will be the value of s in any part of the revolution; for, after the crank passes the horizontal line C D″, the cosines of s become negative. Thus, when the crank is in the position C D‴, s will be equal to D‴ U‴, or to $r—r \cos x$, the same as before. We have, therefore,

$$\left.\begin{aligned} s &= r - r\cos x \\ \text{or } s &= r\,(1-\cos x) \end{aligned}\right\}(a)$$

Again, when the crank is in any position C D′, the eccentric will also have moved over an arc V V′, equal D D′ or to x. So that the distance s' will be equal to $k\,f$, or to $r' + \text{V}'m$.

$$\text{That is, } s' = k\,f$$
$$\text{But } k\,f = r - r\cos \text{arc V}'\text{V } k.$$

Now the arc V′ V k may be considered as made up of three parts, viz., k V or 90°, V V′ or x, and lastly, Q V, the length of which is determined by the quantity of cover (c) and the lead (l); the arc V V′ being always such that its sine multiplied by r' may be equal to $c + l$. We will therefore have,

$$\text{arc } k \text{ V V}' = 90^\circ + \sin^{-1}\frac{c+l}{r'} + x^{*}$$

For simplicity in the notation let us put

$$90^\circ + \sin^{-1}\frac{c+l}{r'} = d$$
$$\text{Then, arc } k \text{ V V}' = d + x$$
$$\text{And } k\,f = r' - r'\cos(d+x)$$
$$\text{But } k\,f = s'$$
$$\therefore s' = r' - r'\cos(d+x)$$
$$\left.\begin{aligned} \text{Or } s' &= r'\left\{1-\cos(d+x)\right\} \\ \text{Or } s' &= r' \operatorname{vers}(d+x) \end{aligned}\right\}(b)$$

Now the arc x is evidently equal to the arc whose versed sine to the radius r is equal to s, that is,

$$x = \operatorname{vers}^{-1}\frac{s}{r}$$
$$\text{Or } x = \cos^{-1}\left(\frac{r-s}{r}\right)$$

Substituting, therefore, in the last two equations, the values of x and d, we shall have

$$\left.\begin{aligned} s' &= r'\left\{1 - \cos\left(90^\circ + \sin^{-1}\frac{c+l}{r'} + \cos^{-1}\frac{r-s}{\text{r}}\right)\right\} \\ \text{Or } s' &= r' \operatorname{vers}\left(90^\circ + \sin^{-1}\frac{c+l}{r'} + \operatorname{vers}^{-1}\frac{s'}{r}\right) \end{aligned}\right\}(\text{A})$$

Again, from formula (b) we have

$$r' - s' = r'\cos(d+x)$$
$$\therefore \frac{r'-s'}{r'} = \cos(d+x)$$
$$\text{Hence, } d + x = \cos^{-1}\frac{r'-s'}{r'}$$
$$\therefore x = \cos^{-1}\frac{r'-s'}{r'} - d$$

Substituting this value of x in formula (a) we have,

$$s = r\left\{1 - \cos\left(\cos^{-1}\frac{r'-s'}{r'} - d\right)\right\}$$
$$\text{Or } s = r \operatorname{vers}\left(\cos^{-1}\frac{r'-s'}{r'} - d\right)\Big\}$$

Substituting for d its value, we get,

$$\left.\begin{aligned} s &= r\left\{1 - \cos\left(\cos^{-1}\frac{r'-s'}{r'} - 90^\circ - \sin^{-1}\frac{c+l}{r'}\right)\right\} \\ \text{Or } s &= r \operatorname{vers}\left(\operatorname{vers}^{-1}\frac{s'}{r'} - 90^\circ - \sin^{-1}\frac{c+l}{r'}\right) \end{aligned}\right\}(\text{B})$$

Either of the formulas (A) will readily enable us to find by the aid of a table of natural sines, the value of s', or the position of the valve for any value of s, and conversely either of the formulas (B) will give us the value of s, corresponding to any value of s'.

We may now proceed to investigate a formula that will give the amount of the cover on the steam side that is requisite to cause the steam to be cut off at any required part of the stroke.

The steam, when the piston is going down, will be cut off when the edge of the valve E comes to the edge of the port F during the upward motion of the valve. Now this will happen when the eccentric is in some position C V‴, such that the sine of the arc V‴ Q′ is equal to the cover on the steam side. But when the crank has made half a revolution, or reached its lowest position, the eccentric will also have made half a revolution, and will be in the position C V⁗. It thus appears that, when the steam is cut off, the crank has described an arc of 180 degrees, minus the arc V‴ V⁗. Supposing, therefore, that C D‴ represents the position of the crank when the steam is cut off, we will have the arc D D″ D‴ = arc V V′ V‴. But the distance of the piston from the top of the cylinder, when the steam is cut off (call this distance s'') is equal to the radius of the crank (r), plus the cosine C U‴ of the arc D‴ D⁗. We have, therefore,

$$s'' = r + r\cdot\cos \text{D}'''\,\text{D}'''' = r + r\cos \text{V}'''\,\text{V}^4$$
$$\therefore \cos \text{V}'''\,\text{V}^4 = \frac{s''-r}{r} \;.\;.\;.\;.\;.\;(f)$$

Again, this arc V‴ V⁴ is composed of two arcs Q′ V‴ and Q′ V⁴.

Sine Q′ V‴ to radius r' we have already seen is equal to the required cover on the steam side, that is, $\sin \text{Q}'\,\text{V}''' = \frac{c}{r}$ and since Q′ V⁴ = Q V, we have

$$\sin \text{Q}'\,\text{V}^4 = \frac{c+l}{r'}$$

The lead is generally very small, and therefore these two arcs, Q′ V⁴ and Q′ V‴, are very nearly equal: so that it will be sufficiently accurate for practical purposes if we make c, the required cover on the steam side, equal to $r' \sin \frac{1}{2} \text{arc V}'''\,\text{V}^4 - \frac{1}{2} l$, That is, $c = \sin \frac{1}{2} \text{arc V}'''\,\text{V}^4 - \frac{1}{2} l \;.\;.\;.\;.\;(g)$

By a well-known trigonometrical formula,

$$\sin \tfrac{1}{2}\,\text{V}'''\,\text{V}^4 = \sqrt{\left(\frac{1-\cos \text{V}'''\,\text{V}^4}{2}\right)}$$

Substituting in this the value of V‴ V⁴, from formula (f), we get

$$\sin \tfrac{1}{2}\,\text{V}'''\,\text{V}^4 = \sqrt{\left\{\frac{1-\dfrac{s''-r}{r}}{2}\right\}}$$
$$\therefore \sin \tfrac{1}{2}\,\text{V}'''\,\text{V}^4 = \sqrt{\left(\frac{2\,r-s''}{2\,r}\right)}$$
$$\text{Hence } (g),\quad c = r'\sqrt{\left(\frac{2\,r-s''}{2\,r}\right)} - \tfrac{1}{2}\,l \quad (\text{C})$$

The cover that is necessary on the steam side to cause the steam to be cut off at any proposed part of the stroke, may be ascertained from this formula, by substituting for s'', in the second member, the proposed length of stroke to be made before the steam is cut off.

The three formulas A, B, and C, which we have now investigated, will enable the engineer to solve any questions that are likely to arise respecting the working of the slide-valve, and will frequently obviate the necessity of the very common practice of making wooden models of the valve to see how it will work, or how much cover it ought to have. The formulas are easily worked, and require in general but little calculation. The only auxiliary required is a table of natural sines, which is to be found in almost every collection of trigonometrical tables.

As an example of the application of formula (C)

			inches.
Let the stroke of the engine . .	.	=	60
Or	r	=	30
The stroke of the valve . .	.	=	10
Or	r'	=	5
Lead	.	=	$\frac{1}{4}$
s''	.	=	45

It is required to find how much cover the valve should have on the steam side to make the steam be cut off, when the piston is 45 inche from the beginning of the stroke. We have (C)

$$c = 5\sqrt{\left(\frac{60-45}{120}\right)} - \tfrac{1}{8} = 2\tfrac{3}{8} \text{ inches, the amount of}$$

cover required to produce the given amount of expansion.

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zontal at half stroke of the piston. Thus suppose C O (Fig. 3, plate 4,) to be the crank, and O P the connecting-rod. Suppose P′ and P″ to be the extremities of the stroke of the point P. P′ D and P″ E will both be equal to P O, and therefore, if P is the position of the cross-head at half stroke, P C will also be equal to P O. Hence it is that the crank must always be below the horizontal line at half stroke, and the shorter the connecting-rod is in proportion to the crank, the more will the crank at half stroke deviate from the horizontal position.

The motion of the valve, however, not being affected by the shortness of the connecting-rod, will, so far as *it* is concerned, work, in relation to the crank, exactly as if the connecting-rod were infinitely long. That is, when the crank is horizontal, the valve will be in the position properly corresponding to half-stroke.

This, it will be readily perceived, is of no consequence to the working of the engine. The grand point is to get the valve to work correctly at the critical moment when the piston approaches either end of its stroke, and is changing the direction of its motion.

The derangement produced by a short eccentric-rod is of little practical importance from the same cause.

The valve being placed correctly when the piston is at the end of the stroke, the only effect of the short valve connecting-rod will be to make the valve travel a little farther one way than it does the other, or, what is the same thing, the valve will be a little more open at half stroke, when the piston is going one way, than when it is going the other.

* Sin^{-1} A means the arc whose sine is equal to A. Cos^{-1} A means the arc whose cosine is equal to A, and so on.

As an example of the application of formula (C), we may apply it to the same case.

We have found that the cover should be $2\frac{3}{8}$ inches to make the steam be cut off at three-quarters of the stroke. By formula (C) we may now verify our calculation, and—supposing the valve to be made with a cover of $2\frac{3}{8}$ inches—we can see whether or not it will cut the steam off at the proper part of the stroke.

Supposing the piston to be moving downwards, when the steam is cut off, the valve is below its middle position by the length of the cover $2\frac{3}{8}$ inches, and when at its middle position, it is half the length of its stroke (5 inches) below its highest position; hence $s' = 7\frac{3}{8}$, or $s' = 7{\cdot}375$: The values of the other letters will be the same as before. We will have, therefore,

$$\cos^{-1}\frac{r' - s'}{r'} = \cos^{-1} - {\cdot}475 = 118\tfrac{1}{2}^\circ \text{ or } 241\tfrac{1}{2}^\circ$$

Both these arcs have their cosines equal to $-{\cdot}475$; so that we may take either of them.

$$\text{Also, } \sin^{-1}\frac{c + l}{r'} = \sin^{-1}{\cdot}525 = 23^\circ$$

and we have (C)

$$s = r\left\{1 - \cos\,(118\tfrac{1}{2}^\circ - 90^\circ - 32^\circ)\right\} = r\left\{1 - \cos 3\tfrac{1}{2}^\circ\right\}$$

$$\text{Or, } s = r\left\{1 - \cos\,(241\tfrac{1}{2}^\circ - 90^\circ - 32^\circ)\right\} = r\left\{1 - \cos 119\tfrac{1}{2}^\circ\right\}$$

according as we take the first or second value of $\cos^{-1}\frac{r' - s'}{r'}$

$$\begin{aligned} \text{Now, } \cos 3\tfrac{1}{2}^\circ &= 0{\cdot}9981 \\ \text{And, } \cos 119\tfrac{1}{2}^\circ &= -0{\cdot}4924 \\ \text{Hence, } s &= 30\,(1 - {\cdot}9981) \\ \text{Or, } s &= 30\,(1 + {\cdot}4924) \\ \therefore\ s &= {\cdot}057, \text{ or } 44{\cdot}76. \end{aligned}$$

The second value of s is evidently the one required for our present purpose, and shows that the steam will be cut off at 44·76 inches from the beginning of the stroke, which agrees very nearly with our former calculation, which made a cover of $2\frac{3}{8}$ inches cut the steam off at 45 inches from the beginning of the stroke.

With regard to the above calculation it may be remarked, that there are an infinite number of arcs which have their cosines equal to —·475, but if we were to take more of these arcs it would be found, that they would ultimately all give one or other of the results we have already obtained, so that it is unnecessary to take more than the first two of them.

The reason that we get two values for s, is this. For each position of the valve there are two corresponding positions of the piston; the one being its corresponding position when going downwards, and the other when going upwards. The second value we got for s, therefore, shows us that when the piston is moving upwards, the valve will begin to open the port, *a*, when the piston is ·057 inch from the top of its stroke. By increasing the cover on the steam side of the valve, any amount of expansion may be obtained, and we might thus obviate the necessity of using expansion-valves, were it not that increasing the cover on the steam side beyond moderate limits, deranges the working of the exhausting ports. A valve with much cover on the steam side must always shut the exhausting port considerably before the piston has reached the end of the stroke, while it at the same time opens a passage to the condenser for the steam that is acting expansively, and thereby entirely removes the propelling power before the piston has completed its stroke. In the valve we have taken as an example, the operation of this kind of valve in producing expansion is carried too far, or at least to the utmost allowable limits. As another example of the use of formula (C) we shall apply it to the same valve to ascertain to what extent the objections we have just described apply in this instance. Let us suppose that the cover on the exhausting side (c') is $\frac{1}{2}$ inch, we would then have the exhaustion below the piston cut off when the valve is $5\frac{1}{2}$ inches below its highest position.

In other words we will have $s' = 5\frac{1}{2}$

$$\text{Then, } \cos^{-1}\frac{r' - s'}{r'} = \cos^{-1} - {\cdot}1 = 96^\circ \text{ or } 264^\circ$$

$$\text{And as before, } \sin^{-1}\frac{c + l}{r'} = 32^\circ$$

$$\begin{aligned} \text{Hence } s &= 30\,(1 - \cos 26^\circ) \text{ or } 30\,(1 - \cos 142^\circ) \\ \therefore\ s &= 3{\cdot}03 \text{ or } s = 53{\cdot}64 \end{aligned}$$

We thus see that the exhaustion below the piston would be cut off when the piston is still about $6\frac{1}{2}$ inches from the bottom of its stroke. The other value of s shows that, when the piston is going upwards, the exhausting passage for the steam below it would be opened when the piston was still 3·03 inches from the top of the stroke.

In what precedes we have spoken exclusively of the common short slide valve, such as is represented in the figure; but the long D valve works on exactly the same principle; only in it the exhausting sides of the ports are usually reversed. The steam generally enters the cylinder from the insides of the ports, that is, from K and M, and exhausts at F and G.

The formula (C) however, will apply to the long slide without alteration, and the other two formulas (A and B) require only one sign to be changed. For the long D valve these two formulas will stand thus:—

$$\left.\begin{aligned} s' &= r\left\{1 - \cos\left(90^\circ - \sin^{-1}\frac{c + l}{r'} + \cos^{-1}\frac{r - s}{r}\right)\right\} \\ \text{or } s' &= r.\,\text{vers.}\left(90^\circ - \sin^{-1}\frac{c + l}{r'} + \text{vers.}\,\frac{s}{r}\right) \ldots \end{aligned}\right\} \text{(A)}$$

$$\left.\begin{aligned} s &= r\left\{1 - \cos\left(\cos^{-1}\frac{r' - s'}{r'} - 90^\circ + \sin^{-1}\frac{c + l}{r}\right)\right\} \\ \text{or } s &= r.\,\text{vers.}\left(\text{vers.}^{-1}\frac{s'}{r'} - 90^\circ + \sin^{-1}\frac{c + l}{r}\right) \ldots \end{aligned}\right\} \text{(B)}$$

The principal results of the foregoing observations may be expressed in the four following practical rules, applicable alike to short slide and long D valves.

RULE I.—*To find how much cover must be given on the steam side in order to cut the steam off at any given part of the stroke.*

From the length of the stroke of the piston, subtract the length of that part of the stroke that is to be made before the steam is cut off. Divide the remainder by the length of the stroke of the piston, and extract the square root of the quotient. Multiply the square root thus found by half the length of the stroke of the valve, and from the product take half the lead, and the remainder will be the cover required.

RULE II.—*To find at what part of the stroke any given amount of cover on the steam side will cut off the steam.*

Add the cover on the steam side to the lead; divide the sum by half the length of stroke of the valve. In a table of natural sines find the arc whose sine is equal to the quotient thus obtained. To this arc add 90°, and from the sum of these two arcs subtract the arc whose cosine is equal to the cover on the steam side divided by half the stroke of the valve. Find the cosine of the remaining arc, add 1 to it, and multiply the sum by half the stroke of the piston, and the product is the length of that part of the stroke that will be made by the piston before the steam is cut off.

RULE III.—*To find how much before the end of the stroke, the exhaustion of the steam in front of the piston will be cut off.*

To the cover on the steam side add the lead, and divide the sum by half the length of the stroke of the valve. Find the arc whose sine is equal to the quotient, and add 90° to it. Divide the cover on the exhausting side by half the stroke of the valve, and find the arc whose cosine is equal to the quotient. Subtract this arc from the one last obtained, and find the cosine of the remainder. Subtract this cosine from 2, and multiply the remainder by half the stroke of the piston. The product is the distance of the piston from the end of its stroke when the exhaustion is cut off.

RULE IV.—*To find how far the piston is from the end of its stroke, when the steam that is propelling it by expansion is allowed to escape to the condenser.*

To the cover on the steam side add the lead, divide the sum by half the stroke of the valve, and find the arc whose sine is equal to the quotient. Find the arc whose cosine is equal to the cover on the exhausting side, divided by half the stroke of the valve. Add these two arcs together, and subtract 90°. Find the cosine of the residue, subtract it from 1, and multiply the remainder by half the stroke of the piston. The product is the distance of the piston from the end of its stroke, when the steam that is propelling it is allowed to escape to the condenser.

N.B. In using these rules all the dimensions are to be taken in inches, and the answers will be found in inches also.

By inadvertence, in this article, V″ and V″″ have been used indiscriminately. They both refer to the same letter in the figure.

The reader is also requested to correct the following errata in the letters on the figure:—

D has been put for D″
V . . . . V″″
P . . . . P′
And the line V *n* has been omitted.

ART. XV.—ANALYSIS OF BOOKS.

Wood Pavement, and its advantages, with a view of the different systems. By A. B. BLACKIE. London: Simpkin and Marshall. 1842.

This work professes to show the advantages of wood over every other description of paving in cheapness, durability, noiselessness, cleanliness, and facility of repair. It also investigates the pretensions of the different kinds of wood paving hitherto projected, and gives the preference to the hexagonal block of Mr. Stead, by whom it appears the wood pavement was originally introduced. It appears to us, that the question of the form of the blocks is one of greatly subordinate importance to that of the use of wood as a paving material; *any* form of block may, we conceive, with a good foundation be made to answer very well; so that, the whole consideration under this head resolves itself into the question, which form is the most economical? Mr. BLACKIE says, that the hexagon pavement is a third cheaper than any other, but we should hardly imagine there can be so great a difference. We purpose, however, to take an early opportunity of investigating thoroughly the merits of wood paving, and the relative pretensions of the rival projectors. In the meantime we may commend Mr. BLACKIE's book to those interested in the subject.

Architectural Engineering and Mechanical Drawing-book for the use of Students London: Weale. Folio.

We have often heard the difficulty of obtaining suitable examples for the instruction of youths in mechanical drawing made a subject of complaint; and in the absence of any work on the subject, have at different times lent to preceptors drawings of our own, some of which were, of course, damaged by the tyros, and others lost. This work will induce us to set our face against all such compliances for the future, and leaves teachers without any pretext for applying for examples of engineering or architectural works to practical men. The examples are well chosen, the plates well engraved, and the work is wonderfully cheap.

ART. XVI.—MARVELS OF THE DAY.

MECHANICAL PILOT.

A machine which will represent on a sheet of paper the track of a vessel at sea.

This we look upon as one of the extraordinary inventions to which the present age has given birth. A species of clock is put into a vessel, and there fixed to a certain part of the mechanism a pencil is attached, and the clock is of course regularly wound up. At the end of the voyage, the pencil will have traced the precise course of the ship, however irregular or tortuous, and that too on a determinate scale. Conversely, if a map on which the required route is laid down be substituted for the sheet of paper, and the ship be so steered, that the pencil will retrace the same line, the ship may be conducted from port to port, without any aid from navigation. In the present state of the machine, however, it does not take cognizance of currents, or lee way, and will be so far inexact in its indications as the ship affected by those agents. We have been favoured with the following exposition of the nature of the mechanism, which we fear, however, will be scarcely intelligible to many of our readers without detailed drawings.

The balance wheels regulate the speeds of the mechanisms, (which in Fig. 1. are marked a, a'',) consisting of fusee spring and scapement; hence, whatever affects the motions of the balance wheels, affects the speed of a, a''. On the main spindle of a, there is a wheel b, fixed so that when the spindle makes a turn the wheel also makes a turn; also on the same spindle there is a loose wheel g, which is wrought by the wheel h, fixed on the spindle of a''; again j, a wheel loose on the spindle of a, has a wheel d, on one of its arms capable of revolving about its own centro, and which works in the teeth of g and b, also the wheel e is on the same arm of j, with d, and is connected with d, so that if d makes a turn, e shall also make a turn; hence, since e works in f, its motion will be proportionate to the motion of d.

Now, if b and g turn in opposite directions, the wheel d, will be carried round at a speed proportionate to the difference of the speeds of b and g. Also, (as will be seen hereafter,) e being wrought by d, so works f, that the speed of f, is at its maximum, when j is at its minimum and *vice versa*. To investigate this clearly denote the diameters of the wheels by the letters marked on them; also, the number of turns each of them makes, by a mark added to the letters, such as $b_{,}$. Following this notation,

$$j_{,} = \tfrac{1}{2}\,(b_{,} - g_{,})$$

This immediately appears by considering that b and g turn in different directions.

If d did not move out of its place, then, $b_{,} : d_{,} : : d : b$, but in the time that b makes $b_{,}$ only $b_{,} - j_{,}$ operate in turning d about its centre; hence, $b_{,} - j_{,}$; or $b_{,} - \frac{1}{2}\,b_{,} + \frac{1}{2}\,g_{,} = \frac{1}{2}(b_{,} + g_{,}) : d_{,} :: d : b$. Hence, $d = \frac{1}{2} \times \frac{b}{d} \times (b_{,} + g_{,})$ or, which is the same thing, $e_{,} = \frac{1}{2}\,\frac{b}{g}\,(b_{,} + g_{,})$ Again, $e_{,} : f_{,} : : f : e$, or $\frac{1}{2}\,\frac{b}{d}\,(b_{,} + g_{,}) : f_{,} : : f : e$. Hence, $f_{,}$ so far as the motion round its centre imparted to it by e is concerned, is equal to $\frac{1}{2}\,\frac{e}{f} \times \frac{b}{d}\,(b_{,} \times g_{,})$ But the absolute motion of f round its centre is $f_{,} = \frac{1}{2}\,\frac{e}{f} \times \frac{b}{d}\,(b_{,} + g_{,}) + \frac{1}{2}\,(b_{,} - g_{,})$

Now, since as in the drawing it is intended that f and $j_{,}$ shall be the wheels which communicate the relative velocities to the pencil and paper, it is necessary that their motions vary in the manner indicated above.

In considering the values of $j_{,}$ and $f_{,}$ it may be well to take the particular case or rather make the particular supposition, that neither $b_{,}$ nor $g_{,}$ can either go slower or faster than certain speeds; and that the greatest speed of either is when, while it is variable, it reaches the speed of the constant. If in the values of $j_{,}$ and $f_{,}$ $g_{,}$ is diminished the value of $j_{,}$ is increased whereas the value of $f_{,}$ is diminished; again by taking $g_{,}$ constant, which it only is when at its greatest speed and then equal to $b_{,}$ and diminishing $b_{,}$ the absolute value of $j_{,}$ is increased whereas the value of $f_{,}$ is diminished; hence we see that, whatever values be given to $e_{,}$ $f_{,}$ $b_{,}$ $d_{,}$ and $\frac{1}{2}l_{,}$; if the value of $b_{,}$ and $g_{,}$ vary as has been before mentioned, the magnitudes of $j_{,}$ and $f_{,}$ will vary in the desired ratios. More, however, is necessary than that, $j_{,}$ and $f_{,}$ vary in the desired ratios; for the minimum value of each must be nothing, and in that case the direction in which the ship is going has all the influence necessary on the relative speeds of the wheels $j_{,}$ and $f_{,}$ now by looking to the drawing it is evident that the minimum value of $j_{,}$ can be nothing, but the minimum value of $f_{,}$ cannot be nothing without something additional, this however can with no great difficulty be added.

The next object must be to find expressions for $j_{,}$ and $f_{,}$ in terms of functions of the angle of variation of the needle, such as will enable us to compute the real velocities of the wheels j and f.

In order to do this, first consider what would be the state of the case, supposing the ship to move during her whole voyage in a straight line, and with equal speed; on this supposition the line drawn on the paper should be straight from E to F; (Fig. 4, Plate IV.); hence we have the means of determining the relative magnitudes of the distance passed over by the ship, and the distance passed over by the pencil. Suppose now that the ship moved in a direction corresponding to A B, so that the pencil may have described the line A B, the paper must have moved along a distance equal to D B, and the pencil must have travelled across the paper a distance equal to A D; by examining the figure it is apparent that $AB^2 = DB^2 + DA^2$ that is, if D B represents the motion of j and D A the motion of $f_{,}$ $AB^2 = j_{,}{}^2 + f_{,}{}^2$. Again, if D B A represents the whole variation of the needle from the position in which it was when the ship started, which denote by (ϕ,) then by the figures

$$DA : DB :: \sin\phi : \cos\phi \text{ or } f_{,} : j_{,} :: \sin\phi : \cos\phi \text{ hence}$$

$$j_{,} \times \sin\phi = f_{,} \times \cos\phi \text{ or } \frac{\sin\phi}{\cos\phi} = \tan\phi = \frac{f_{,}}{j_{,}} \text{ but from}$$

$$AB^2 = j_{,}^2 + b_{,}^2 f = \sqrt{\left(AB^2 - j_{,}^2\right)}\,;\ \text{hence}$$

$$\tan\phi = \frac{\sqrt{\left(AB^2 - j_{,}^2\right)}}{j_{,}} = \frac{1}{\tan\phi} = \cos\phi = \sqrt{\frac{j_{,}}{\left\{AB^2 - j_{,}^2\right\}}} \text{ in the}$$

same way it could be found that $\tan.\ \phi = \dfrac{f_{,}}{\sqrt{\left\{AB^2 - f_{,}^2\right\}}}$

Two equations have now been found such, that for a uniform speed A B of the ship, the velocities of j and f can be computed for all directions of the needle.

Hitherto no means have been supplied such as to enable the speed of the vessel to modify the line described on the paper. This deficiency, however, is made up in the following way:—

Thus, the wheel f works k, and on the same spindle with k there is a wheel z, which has a pin e' in a connecting-rod: this pin, e' is attached to a clutch $f_{,}'$ which clutch can be wrought back and forward on the spindle of k, by the water; now the water, by pushing the clutch towards z, pushes the pin e' from the centre of z, and of consequence gives the outer end of the connecting-rod a greater throw, but the connecting-rod, by having a greater throw, turns the ratchet-wheel y faster; again, the ratchet-wheel, through the medium of wheels w and x, works v, and k works s, so that the wheels s and v may go in different directions; hence, if a wheel u works in the teeth of s and v, it will turn round a wheel t, which may be attached to it, with a velocity proportionate to the difference of the velocities of s and v; therefore the speed of the vessel can regulate the velocity with which t turns upon its centre, it can reduce the speed of it to nothing when the speed of the ship is nothing, or it can make the speed of it infinite when the velocity of the ship is infinite, provided the wheel z be of large enough diameter.

The same means may be applied to modify the line representing the speed of j, according to the speed of the ship.

THE BEDFORD OFFICES.

These offices have been erected for the Duke of Bedford, by Mr. Cubitt, of Gray's Inn-road, and are a masterpiece of constructive science, both as regards design, materials, and workmanship. The most fastidious critic will, we believe, fail in finding any thing he could find fault with throughout the whole building, or change in any respect for the better; and every judicious observer will find an infinite deal to applaud and admire. For our part, we must conscientiously say, that we have not seen any modern building which comes more up to our ideas of what a building of the kind should be, or reflects higher honour on all concerned in rearing it. It is not, to be sure, a building of any great size, nor of any architectural pretensions; and will not, therefore, attract the same notice as more ambitious constructions, or elicit the applause of the vulgar: but, to the man of the least skill in constructive science, or, indeed, to the man of ordinary good sense, it will appear infinitely more admirable than those stately piles reared by dint of money alone, according to established prescription, and in which no ingenuity is displayed, and no difficulty surmounted. We trust that the Duke of Bedford will order the publication of the details of the construction of these offices, so as to serve for a model for other offices throughout the kingdom.

The leading principle kept in view in the design of this building, is to secure effectually all papers deposited in it against *damp* and *fire*. As security against the former, a foundation of concrete, two feet thick, under the entire extent of the building, and extending beyond the outer walls, is laid; and over that brick arches are thrown, with openings for air from one to the other, communicating with similar openings in a dry (covered) area running round the building, in which are grated openings, slightly raised above the pavement, (which covers a space round the building,) to prevent any flow of rain-water into them.

As security against fire, all combustible materials have been excluded from the building, with the sole exception of the floors in the upper rooms, (the building consisting of the muniment room below, on the ground-floor, and of offices on the one pair), which are of oak (as a less combustible wood than deal), of the window-sashes in the rooms on the one pair floor, which are also of oak, and of a swing-door at the entrance, wholly unconnected with any other combustible material. Iron, bricks, tiles, cement, mortar, stone, and slate, are the only other materials used in the construction of the building. The ceiling of the room on the ground-floor is formed of iron and brick arches, and that of the one-pair floor of tiles bedded in cement, and iron; the roof is also formed of tiles bedded in cement and iron. All the doors and shutters are of iron; the window-frames are of slate; and the sashes in the muniment room are of metal.

The floor of the muniment room is of stone laid on brick arches; the floors of the upper rooms are of oak, laid on oak sleepers resting on the arched ceiling (of brick and iron) of the muniment room; and the oak of the floor of each room up stairs is separated from that of the room adjoining it by a stone continuation of the floor.

For want of air to support combustion, if by any means the oak floor could take fire, the probability is that the fire would go out before much more of the floor was consumed than just the part that happened to take fire; but if the whole floor should be consumed, the fire could not extend to the floors of the adjoining rooms, because of the stone separation between them. The burning of one floor is, therefore, all the injury to the building that could result from a fire taking place. In all other parts the building is invulnerable.

The deeds in the muniment room will be contained in tin boxes (no wooden boxes will be admitted into it), ranged from the floor to the ceiling in iron frames or cradles; the doors being in front of the boxes, to make their removal unnecessary in order to get at their contents. The cradles will be so arranged as to give all the box room that can be obtained with due regard to light and convenient access to the boxes; and, to avoid all risk of damp, they will be kept away from the walls of the building; and the position of the boxes will be such, that every box will have the benefit of a free circulation of air all round it.

It was suggested that a roof of iron and tiles bedded in cement would be likely, in sudden changes of temperature, to cause condensation of the moisture in the air in the rooms upon the ceilings of the upper rooms. To prevent this, and preserve an equal temperature in the roof, it has been covered with a layer of well washed cockle-shells, about 18 inches in thickness, which appears to produce the effect intended.

Though the doors and shutters are of iron, their appearance resembles wooden doors and shutters so closely as only to be distinguished from them by close inspection, and they open and shut with equal ease.

No provision has been made for the deposit of plate, jewels, money, or any articles offering a temptation to theft, in order not to expose the deeds (articles literally of "no use to any one but the owner") to the risk of thieves breaking in; and, for the same reason, no money is ever left in the building at night; the receipts of the day being always taken the same day to the bank. Nevertheless, all necessary provision for the security of the building from thieves has been made.

For the foregoing particulars we are indebted to the courtesy of the Duke of Bedford, through C. Hardy, Esq.

SCREW STEAM VESSELS.

The Great Northern.—We have taken an opportunity of visiting this vessel; and never met with a great steamer botched more effectually. This, indeed, the eulogistic paragraphs which have appeared in many of the papers in some degree led us to expect, inasmuch as it is always the worst works which receive most newspaper commendation; and, indeed, it is such works alone which need to rely on such auxiliaries. We look upon this vessel as one damned irretrievably; and it grieves us much to be spectators of so portentous a failure, and to see vast sums of money so insanely dissipated.

We have no doubt the owners and constructors of this vessel will look upon our judgment as intemperate and unjust; but the sober part of the public will as certainly confirm it, in spite of the encomiums of hypothetical literati. Our opinions are not the effect of any second-hand representations. We are unacquainted with any of the parties; and glad should we be if we were enabled to praise instead of being compelled to condemn. But we cannot express other than our honest convictions; and, indeed, it would be mere mockery to gloze a matter over which is visible to all eyes except those the most interested in seeing it. We heartily regret that Mr. Smith's screw is affixed to such a vessel; not that it can in the least impair its value, but that, in vulgar minds, his very meritorious plan is in danger of suffering from so unhappy an association.

It will be expected, however, that we should state our objections a little more specifically. In the first place, then, the vessel is very rudely finished; and although we make no doubt she is composed of sound materials strongly put together, yet this is only a negative quality, and cannot entitle any construction to especial praise. Many of the fastenings, however, we look upon as insufficient for so large a vessel; and, altogether, the whole of the carpenter work, though we should not pronounce it bad, has a very Irish air. This, however, might pass, and is but a small part of the evil. It is the engines to which we chiefly object; and we can with truth say, that never, in *any* steam-vessel, did we see engines so badly planned, or so badly constructed. There are two engines, standing one *before* the other, and situated in the stern part of the ship: the cranks are immediately over the cylinders; and on the intermediate shaft, which is of course parallel to the keel, a great cog-wheel, twenty feet in diameter, is placed, which works into a pinion below, situated on the shaft which gives motion to the screw. The crank is not joined to the piston-rod by means of a connecting rod, but a frame is attached to the piston-rod top, with a great transverse slot for the crank-pin to work in; and as the piston-rod moves up, the crank-pin moves out in this slot, so as to accommodate itself to the piston's altered position: the movement of this frame is restricted to the perpendicular position by strong guides.

There is nothing original in this plan, and much that is bad. The friction is enormous; the wear of the parts rapid; and the difficulty of adjustment considerable. The horizontal groove in which the crank-pin works, it is impossible, we understand, to keep from heating; of which, indeed, the iron of the frame bears evidence—its edges being frayed, and its surface rendered irregular, by the enormous pressure of the travelling crank-pin. The crank-pin may, indeed, be encircled by a friction roller, to mitigate these evils, but this is a futile expedient: the roller must speedily wear a little flat on the one side, and after that it will never turn round.

This radical defect in the plan of the engines is sufficient to work their condemnation singly; but in the structure and distribution of the remaining parts, not a whit more proficiency is displayed. In the lower regions of the engine-house there is a vast complication of pipes winding about like a number of serpents, coming from—no one can tell where, and proceeding to—no one can tell whither. The mode of throwing the eccentric rod out of gear, consists in the application of a rope and pulleys; the upper end of which is attached to the deck, and with which the engineer hauls the rod bodily out of the notch. The starting-lever consists of an immense bar, heavy enough to form the beam of a small engine; and which, before it can be detached from the engine, must be lifted *in toto* from its place; an operation of course impossible when the engine is at work. This bar must, therefore, be in perpetual motion after the engine is set on, and must constitute a source of much danger to the engineer.

It would far transcend our limits to give adequate examples of the *taste* as well as the judgment displayed in this work. We cannot believe that any drawings of the engines were made previous to their construction. The whole is thrown together as if by chance; every part joins every other part, as if it had been forgotten until the part to which it had to be attached was completed, and it had then to be coaxed into its place by bends and patches, and other such convenient suasories. Altogether, the engines are the worst engines we ever saw in any steam-vessel whatever; and those who question the soundness of our judgment need only visit the vessel, and judge for themselves. A monument of incapacity so glaring must excite the secret laughter of the London Engineers; and we think it unfortunate for the owners of this vessel, that she was ever brought to London at all. In the North of Ireland, or any other outlandish region, she might continue to be regarded as a paragon; but the splendour of her fame is dissipated and rendered dim by the juxtaposition of works of real merit; and comparisons are provoked which can only end in convincing even the uninitiated of the hollowness of her pretensions.—It is high time, however, to give some of the dimensions of this uncultivated leviathan, with some of the particulars of her alleged performance:—

	Feet.
Length over all	247
Ditto between perpendiculars	222
Breadth of beam	37
Draught of water at present	16
Intended draught when fully laden . .	19

Tonnage, N. M., 1515; Register ditto, 1115.

The ship has at present 1300 tons of dead weight in her hold, consisting of coals ballast, machinery, &c.; and it is estimated that 700 or 800 tons more would be required to bring her down to 19 feet draught.

Diameter of cylinders, 5ft. 8in.; length of stroke, 4ft. 6in.; number of strokes made per minute, 16 to 17; although they were expected to make from 22 to 23: so that little more than 222 horse-power only has hitherto been exerted.

The screw, which is 11ft. diameter, and set at a pitch of 14ft., consists of two half-turns or threads, which makes it 7ft. in length, and makes four revolutions for one of the engine.

The speed is got up by a simple wheel and pinion. Diameter of wheel, 20ft.; ditto of pinion, 5ft.; cogs are 22 inches on the face, and 6 inches pitch; and are said to work *perfectly noiselessly.* In the large wheel the cogs are of wood. The steam, in this case, is considered merely as an auxiliary, and will only be used in calms, contrary winds, &c.

The ship spreads no less than 6700 yards of canvass; her main-mast is 90 feet long, and 33 inches diameter; the main-yard, 79 feet long, and 22½ inches diameter in the slings; the fore and mizen sheets have yards and rigging in due proportion.

The rate of the *Great Northern* through the water, *under steam only,* is said to be 8 to 8¼ knots, equal to 9½ statute miles per hour. Rate, under steam, and sails *close* hauled, 10½ to 11 knots. Rate, under *sails only* (the screw being disconnected), 13 to 13¼ knots, or nearly 15 miles, the wind being *fresh and free.* Rate, with fresh breeze *ahead*, and smart sea, in the Irish Channel, 4½ to 5 knots. The distance from the Ower's Light Ship to Dungeness, is, by Chart, 66 nautical miles, and was run by the *Great Northern*, on the 25th December, 1842, in 5 hours 2 minutes, under sails only, and the ship not particularly pressed with canvass, having only the fore-topmast and lower studding-sails set the latter part of the time.

Height between decks, 7ft. 8in. Her engines, boilers, &c., with 300 tons of coals in bunkers, occupy just one-sixth of her entire capacity. With 27 to 30 days' fuel on board she has room for 1000 tons of measurement goods below, and accommodation for 800 or 900 troops between decks, according to the Government allotment of space for each man. The machinery being placed right aft, leaves the main and fore-holds perfectly free for mercantile purposes, if required.

By calculating the speed of the screw at 17 revolutions of engine, or 68 of the propeller per minute, and taking the maximum rate of ship in smooth water, viz., 9½ statute miles, the slip is very trifling. The immerged midship section, at 16 feet draught, is considerably above 500 feet. The pressure of steam in the boilers is from 5lbs. to 6lbs. per square inch. There are three boilers of a cylindrical form, having four furnaces in each, with flues of the ordinary kind. The consumption of fuel is, we understand, very heavy, as, indeed, might be expected from the rudeness of the engines, and imperfect quality of the boilers. The existence of the chief weight, moreover, so far aft, is, we conceive, calculated to strain the ship in a sea-way, and make it difficult to preserve her trim.

Screw Tug.—This is a little vessel, constructed by Messrs. Penn, of Greenwich, for the Peninsular and Oriental Steam Navigation Company, for the purpose of towing barges laden with articles destined for India on the Mahmoudie Canal, which extends from Alexandria to the Nile. There are several peculiarities in the mode of her construction; she has approved herself an efficient vessel, and altogether is a very elegant and creditable production. Being required for towing, it was necessary to adopt a large proportion of *power* to *size.* She has two engines of ten horse-power each, to a burden of 40 tons. Her mode of propelling is by *two* screws, or combinations of inclined planes, working not in the dead-wood, but in the run under each quarter; and they answer an excellent purpose—the velocity of the vessel being very great. The hull of the vessel is made of iron plates; and a difficulty arose as to how her qualities might be tested before starting, and yet send her by the *Oriental* on her last voyage, so as to be in operation by the time of the *Hindostan*'s arrival at Suez. This was effected by using *leaden* rivets, which, as soon as the trial was over, vanished on the application of the soldering-iron.

PLATE V

LOCOMOTIVE ENGINE ON THE LONDON AND BIRMINGHAM RAILWAY.

EDWARD BURY.

FIG. 1.

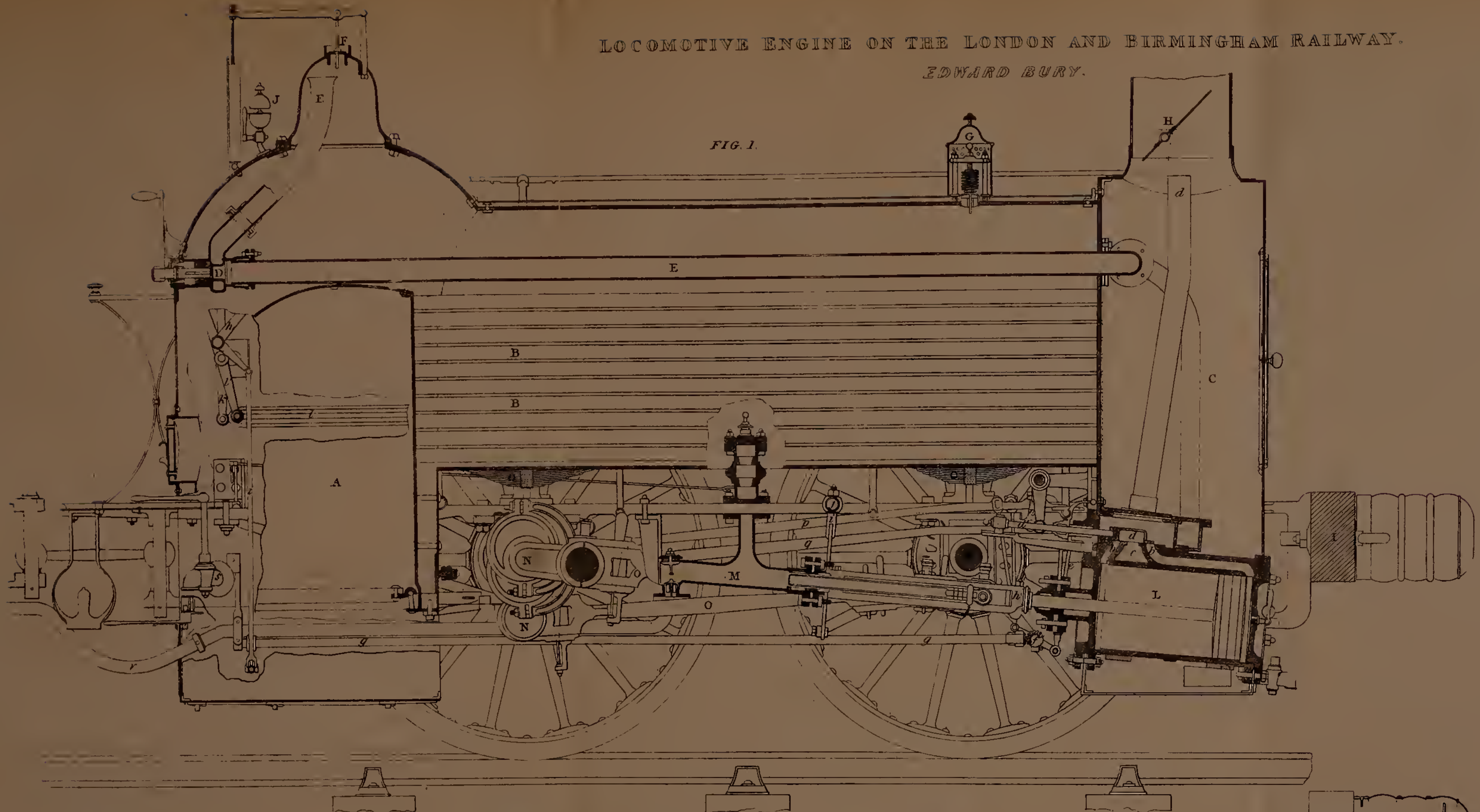


FIG 2.

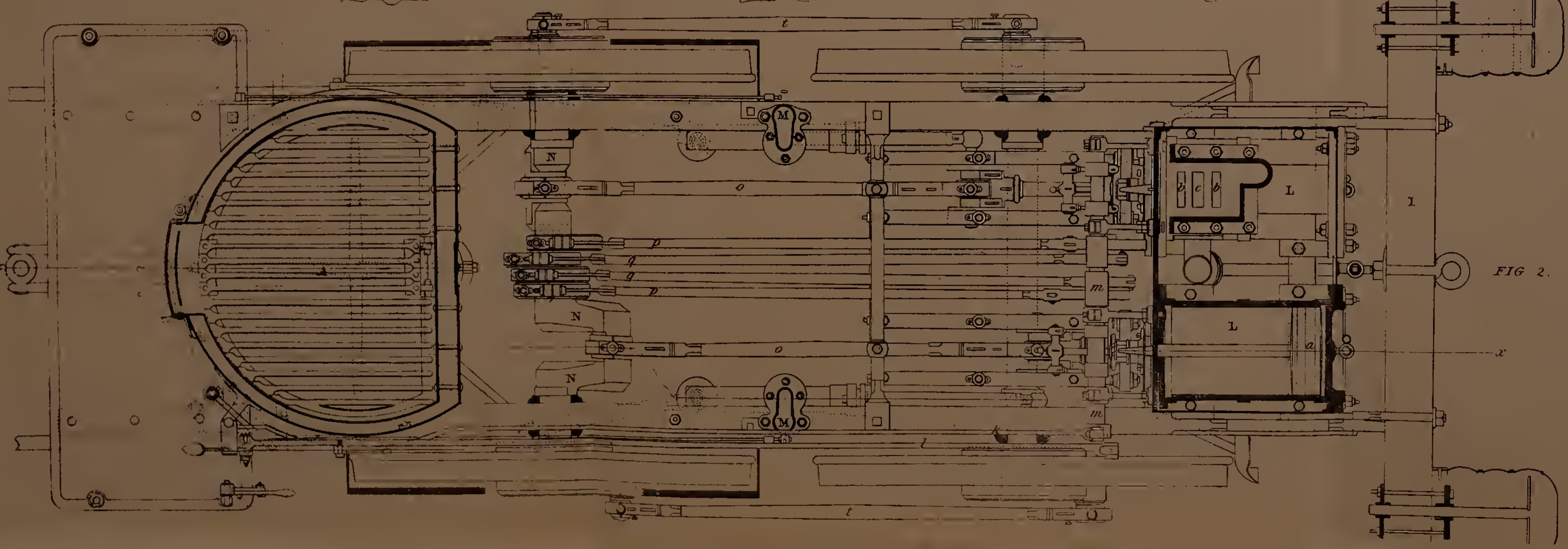
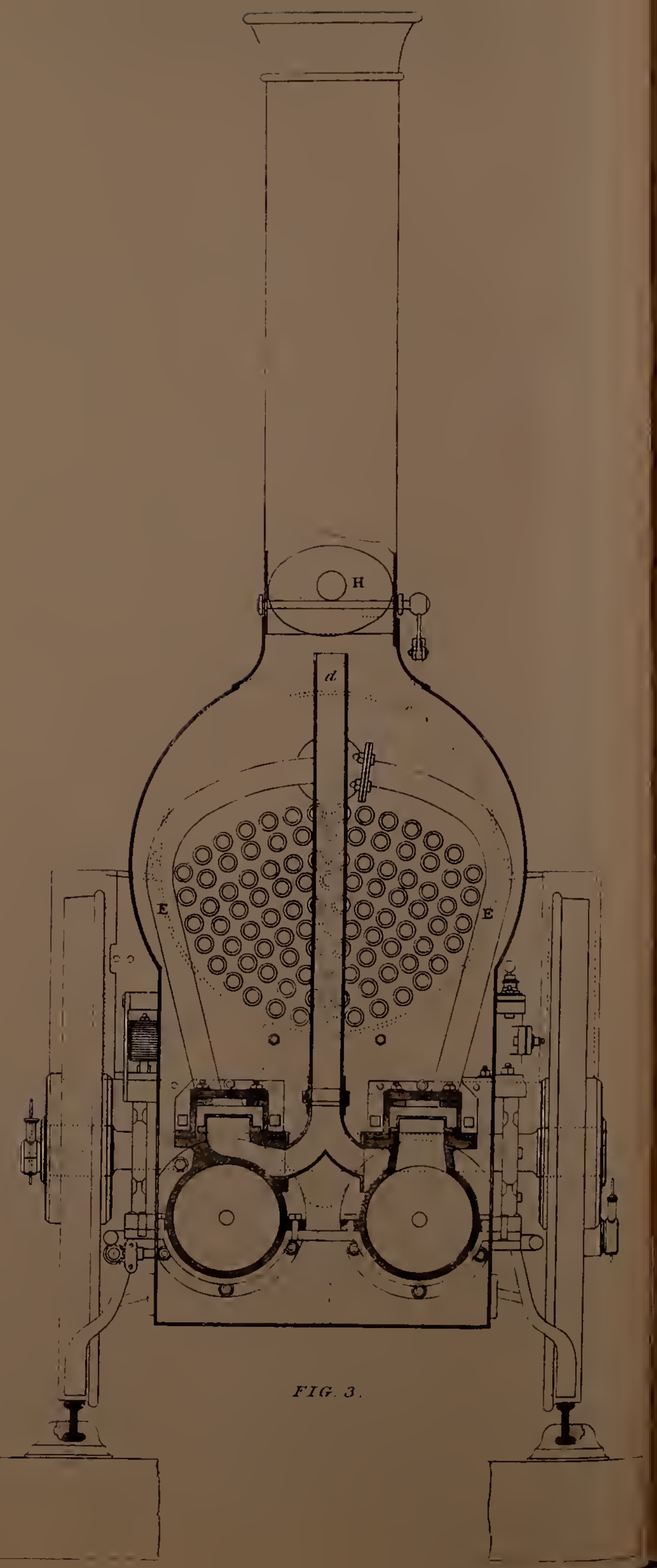
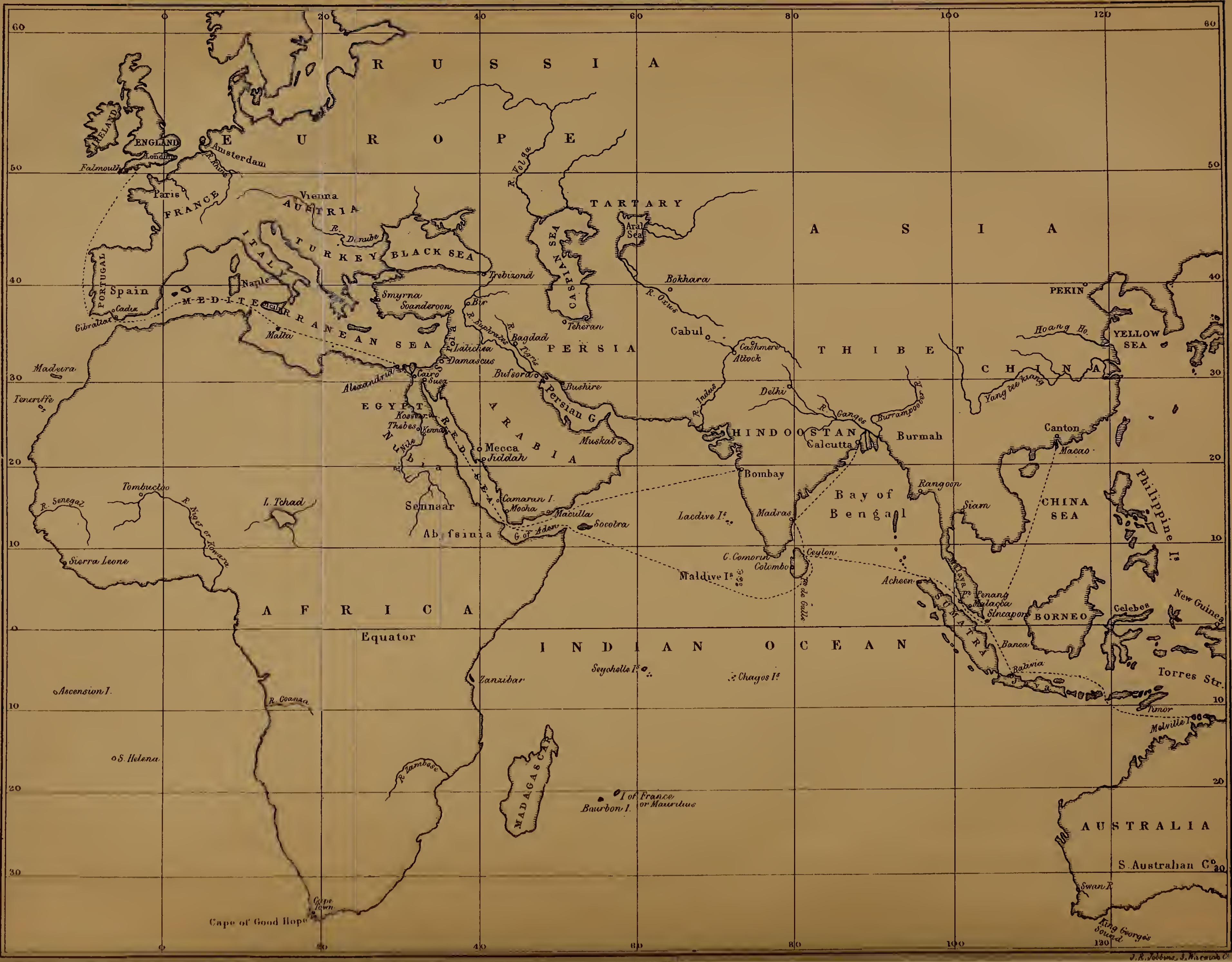


FIG. 3.



ROUTE OF STEAM SHIPS BETWEEN GREAT BRITAIN AND THE EAST.



J. R. Jobbins, 3, Warwick Ct.

EXCERPTS FROM SPECIFICATION OF STEAD'S PATENTS FOR WOOD PAVING.

Declared and Confirmed by Act of Parliament Vic. 4th & 5th Cap. XCI.

Fig. 1.

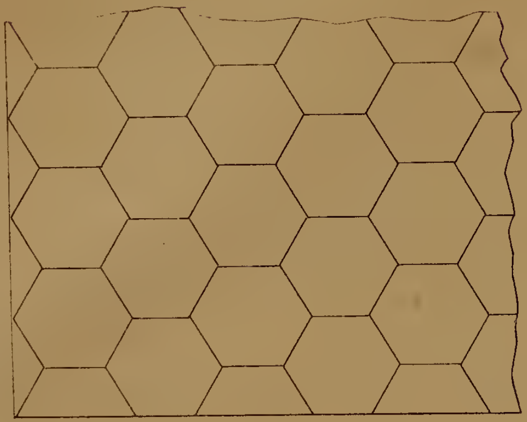


Fig. 3.

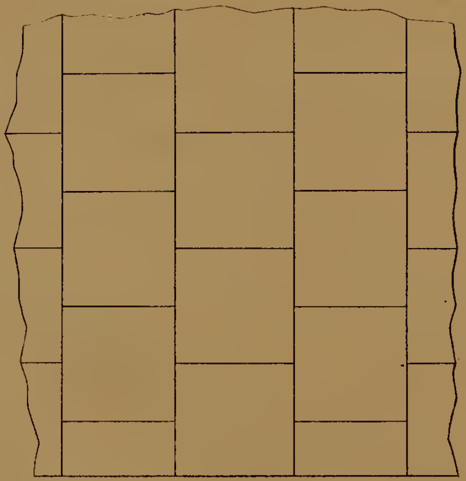


Fig. 5.

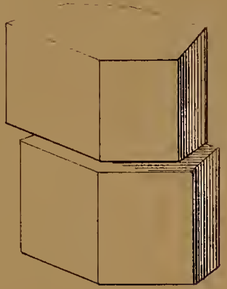


Fig. 7.

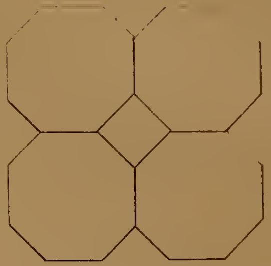


Fig. 8.

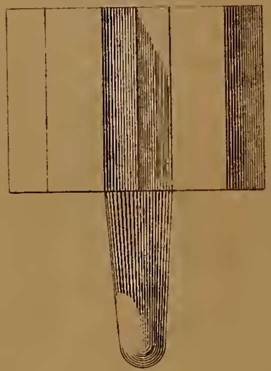
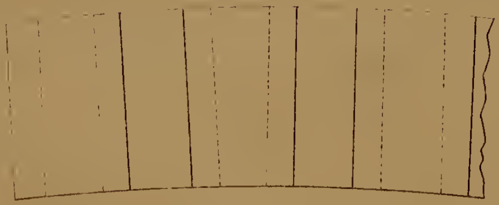


Fig. 2.



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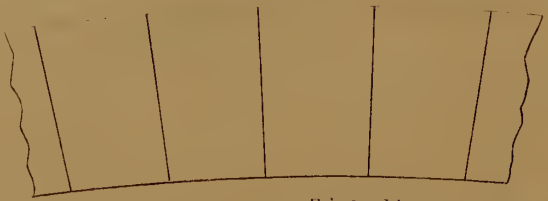

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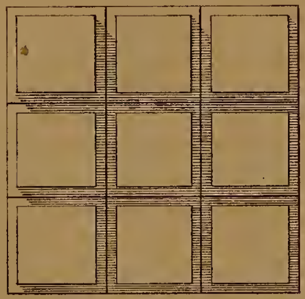

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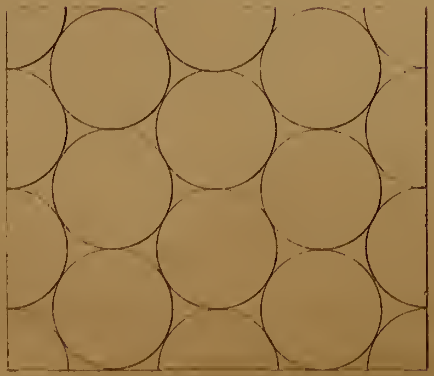

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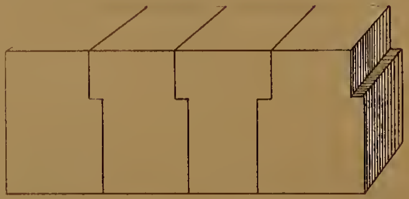

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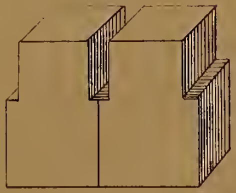

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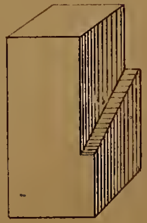

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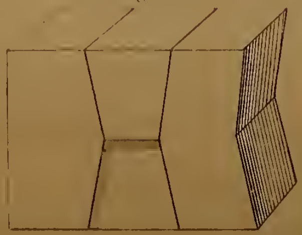

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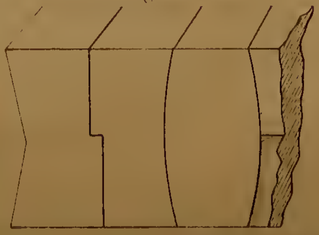

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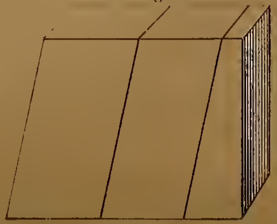

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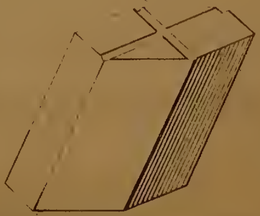

THE ARTIZAN.

No. II.—FEBRUARY 28th, 1843.

Art. I.—DR. LARDNER AND ORIENTAL STEAM VOYAGING.

In our last Number we attempted to illustrate the singularly complete confirmation Dr. Lardner's predictions relative to Atlantic steam voyaging had received from a matured experience. We now propose to inquire how far his views relative to Oriental steam voyaging have stood the application of the same uncompromising test, and whether the same remarkable coincidence between the deductions of science and the demonstrations of actual experiment have been found to obtain in this case also. To this end, it will be necessary to recapitulate the doctrines promulgated by Dr. Lardner respecting Oriental steam voyaging antecedently to its establishment, and compare them with the results of our experience up to the present time; by which means we shall at once see how far they have been invalidated or confirmed.

It is, perhaps, not very generally known that Dr. Lardner's anticipations respecting the issue of any wisely-managed enterprise proposing to maintain a steam communication with India by the way of the Red Sea, were *the very reverse* of those he entertained relative to the Atlantic scheme. Atlantic steam voyaging, he contended, would not answer at all; but Oriental steam voyaging, he confidently predicted, would, under good management, answer exceedingly well; and he showed that these opposite results flowed from the same fundamental principles of steam locomotion. The failure of the Atlantic enterprise, therefore, instead of casting doubts upon Oriental steam voyaging, is, in reality, a weighty *à priori* argument for its perfect success; inasmuch as it establishes the soundness of the principles upon which Dr. Lardner's predictions were founded, and superinduces the belief, that when in the one case those predictions have been fulfilled to the letter, they will be verified in the other case with corresponding fidelity.

At the time Dr. Lardner's sentiments respecting the promising character of Oriental steam voyaging were made public, steam enterprises of every description stood so high in the popular favour, and obtained such universal and unqualified praise, that the commendation of any particular scheme necessarily obtained but very little attention. Dr. Lardner's doctrines on this subject were, therefore, neither wondered at nor called in question, and obtained little comparative notoriety: they were unopposed to the projects of any speculative cabal, and were not, as in the case of Atlantic voyaging, forced into notice by the noisy anger of conspicuous enemies; and many persons are consequently, up to the present time, ignorant that Dr, Lardner ever expressed himself favourably on the subject of Oriental steam transit. For the benefit of these persons, it will be necessary to refer to the records of Dr. Lardner's opinions upon this subject already before the public; the more important parts of which are embodied in his letter to Lord Melbourne, dated 1837. From this publication we shall make some extracts.

> "It has been contended that the measure should not be regarded as one to be determined merely upon a calculation of profit: that, on the contrary, it is one with which great political and social interests are so closely interwoven, that it ought to be adopted even though its entire cost should have to be defrayed by the nation. This principle has been implicitly admitted in the resolutions of the Select Committee of 1834; and it has been explicitly avowed by the late Governor-General, by several honourable members of the Legislature, and of your lordship's administration. But it is a principle which I think it unnecessary to discuss in the present case: because *there is no proposition, however self-evident, which carries to my mind a more clear conviction than I have, that this measure, if efficiently carried into operation, will more than return its own expenses.* In arriving at this conclusion, I put aside all conjectural estimates as to postage, despatches, packages, and merchandise,—assuming that it is morally certain that, subject to the same cost, more than one-half the number of persons passing between Great Britain and India will prefer the shorter to the longer route,—and admitting the extremely improbable supposition, that increased facility and expedition, without any increased expense, will not be attended with any corresponding increase of intercourse."

Three routes have been proposed for a steam communication between Great Britain and India: the first by the Euphrates; the second by the Cape of Good Hope; and the third by the Red Sea. By the Euphrates' route, passengers were to be disembarked at Iskanderoon, at the eastern end of the Mediterranean, and were to be conducted from thence over-land to the Euphrates, where they were to be embarked on board a small river steamer, in which they were to proceed down the Euphrates to the Persian Gulf. They were there to be transferred to a sea-going steamer, by which they were to be conveyed to Bombay. This scheme, after a considerable sum had been expended in bringing it to the test of experiment, was found to be impracticable for all useful purposes. The shallowness of the Euphrates, in a great number of places, renders its navigation impossible by any vessels except those of the lightest draught of water; while the narrowness of the navigable channel in other places confines the breadth of the vessels navigating it to very narrow limits; and the suddenness of some of the turns of the stream circumscribes the length of the vessels. In short, none other than very small steam-vessels could navigate the Euphrates at all; and such vessels could not be made to afford adequate accommodation for India passengers. Vessels of large power would draw too much water, and vessels of a small power would be unable to contend with the current, and the wind which, in the Euphrates, blows *down* the river in the height of the periodical inundation, when, of course, the current is strongest. In addition to all this, any of the narrow channels in the stream might be blocked up by a rock, and the whole flotilla stopped and plundered by the savage tribes which infest the banks of the river.

The grand objection to the route to India by the Cape, is its great length; to which might be added the turbulence of the Atlantic waters in comparison with the relative tranquillity of the Red Sea and Mediterranean. The force and uniformity of the winds, moreover, which a sailing-vessel, on her way to India by the way of the Cape, necessarily encounters, are such as to assimilate her capabilities more nearly to those of a steamer, than can be accomplished among the irregular atmospheric influences of the higher latitudes. In the calms which prevail about the line, a steamer would possess, indeed, a great superiority; but her peculiar powers would be of little comparative avail in the trade-wind of either tropic, or in those land and sea breezes of which a ship can usually take advantage when the trade-wind is opposed to her progress. The difference of time, therefore, between the performance of a Cape voyage to India by a ship and by a steamer, is so inconsiderable, and the expense of transit by the latter mode of conveyance is so much greater, that it is questionable whether the acceleration is worth the expense at which it is necessarily accomplished. Every mile traversed by a steamer entails a corresponding expense; and if there be two practicable routes open to her selection, the shortest is undoubtedly the best. For all coarse and heavy articles of merchandize, the transhipment of which would be inconvenient, and seriously add to the expense of the freight, the route by the Cape will continue to be preferred; but for passengers, letters, and parcels, the Red Sea route is indisputably the best, and must supersede all others. This is very happily shown forth by Dr. Lardner in the following passage:—

> "Nothing but that state of passive acquiescence generated by a long habit of following a certain course, could reconcile a people so commercial and so locomotive as the English to be confined to the route to India by the Cape, since the art of transport by land and water has received those astonishing accessions which have been recently conferred upon it by the steam-engine. The distance from Falmouth to the nearest port of India, by the Mediterranean and the Red Sea, is 5800 miles, of which there are not 200 miles of land, and that through the dominions of a friendly power. The distance usually traversed by sailing vessels, in the voyage by the Cape, is about 16,000 miles. How strong must be the force of habit which reconciles us to such a circuit to reach a place not 6000 miles distant! How over-ruling must that necessity be, which sends persons and correspondence a voyage equal to two-thirds of the circumference of the globe, to carry them less than a fourth of that space! *Primâ facie*, then, the question is not why persons and correspondence should be sent direct to India by the Red Sea, but why, for such a purpose, the present preposterously circuitous route should be still persevered in?"

The objections brought against the Red Sea route are threefold:—1st, the detention caused by quarantine; 2nd, the difficulty of crossing the desert; and, 3rd, the dangers of the navigation of the Red Sea. The first of these difficulties, which was, indeed, by much the most formidable, has already been overcome by keeping the vessels in quarantine during the voyage: the desert is now crossed in omnibuses without any difficulty, and the dangers of the Red Sea navigation have been found to be greatly exaggerated. Dr. Lardner very clearly describes the true character of the Red Sea navigation:—

> "The Red Sea is a long, narrow tract of water, lying nearly north and south, about three degrees in width, and twenty-four in length. Its shores, east and west, are fringed with coral reefs, rendering coast navigation extremely dangerous for sailing vessels. The centre, however, with ample width, is quite free from every obstruction, and is easily and safely navigable by steamers at every season of the year. It is subject to periodical and local winds, characterized by a force and constancy which offer serious impedi-

> ments to the attainment of any degree of expedition by sailing vessels, when adverse to their course; but these would only be so far felt by steamers, that they would somewhat diminish their rate while opposed to their course; offering, however, no more interruption to their regularity and certainty than is produced by the atmospheric vicissitudes in the seas around the coasts of Europe. Indeed, they would produce so much the less inconvenience, as their prevalence and force is more regular, and their effects can be predicted.
>
> “ The coral reefs, which have been held forth as presenting such difficulties, are confined exclusively to the shores on either side, and would never be approached by a steamer following its ordinary route. It would, however, be advisable to have an Arab pilot in the crew of each of the steamers. These pilots are thoroughly acquainted with the anchorages on the coast, and, in emergencies, the steamer could be conducted into harbour either on the eastern or western shores of the sea. There are numerous harbours, as well on the Arabian as on the Abyssinian and Egyptian coasts, which would form places of refuge in cases of accidental derangement, or extraordinary stress of weather.”

It has been objected against the route by the Red Sea, even by some persons of high authority, that it would be opening a highway for Swiss and German manufactures to India, to the serious detriment of our own Indian market. It has been further objected, that, by diverting the current of commerce into its ancient channel, we shall be pouring wealth into the cities of the Mediterranean, and correspondingly impoverishing ourselves; and that while Venice and Genoa may rise to their former magnificence, the commercial greatness of our own country may wither. These objections appear to us empty and puerile. If Swiss and German manufacturers are able to undersell us in the Indian market, shall we be able to hinder them from reaching India, by keeping the Red Sea shut up? And if German manufactures must go to India—an event contingent altogether on the demand there for them—why should we refuse to reap the advantage of their carriage? Is it a hurt to British commerce, that German goods should be carried in British ships, instead of in ships of Germany? The fall of Venice, it is taken for granted, was brought about by the discovery of the Cape passage; and the fall of England, it is feared, may be hastened by the re-establishment of the route by the Red Sea. But we do not believe that the discovery of the Cape passage had anything whatever to do with the fall of the Venetian dominion. Empires, like individuals, flourish and fade; and Venice had long ago reached the period of decrepitude. Genoa divided the empire of the seas with Venice, and she too has fallen; yet it is not pretended that the fall of Genoa is due to the discovery of the Cape passage. The maritime splendour, too, of Spain and Portugal, has long been waxing dim; and the fleets of Holland, which at one time swept the seas, have sunk into insignificance; yet these are the powers which were most immediately benefited by the opening of the Cape navigation, and had most to expect from its boasted advantages. They have sunk in one common ruin with those more ancient states, whose declension is pretended to have been brought about by the discovery of the Cape of Tempests; and their fate only constitutes a page of that universal history which proclaims that there is an ever-changing tide in the destiny of nations; and that when, through long prosperity and enormous wealth, a people has become indolent and corrupt, their greatness inevitably withers, and their glory becomes the heritage of those among whom the sterner virtues continue to flourish, and who, if unblessed by the light of a high civilization, are unafflicted by the sloth and effeminacy which too frequently attend it.

Another objection brought against the Red Sea line, is, that a bigoted barbarian might succeed to the Egyptian pachalic, who would put a stop to all transit; or, that war may break out between Egypt and this country, which must necessarily be fatal to all commercial intercourse. Such events, it must be confessed, may happen, but are by no means very likely at the present time; and who ever before heard of a man being called upon to surrender benefits which were eminent and immediate, because he might not enjoy them through all eternity? Suppose, even, that the interruption of the Egyptian transit, after a given period, were certain, is that any reason why we should not avail ourselves of its advantages as long as we can? or are we to reject a long lease of important benefits, merely because we may not have them in perpetuity? The ships, indeed, by which the communication with India is to be maintained, should possess such capabilities as to be adequate to the performance of the voyage by the Cape; but if the Red Sea route possesses any advantages at all, it is time enough to give it up when it becomes nutenable, an event, we may add, never likely to arise.

The size of the steamers proposed by Dr. Lardner, for Oriental voyaging, was 1000 tons, and we still think this size the best, if reference be had only to the exigencies of the Red Sea line. But, in order to provide against the contingency of an interruption of the route through Egypt, vessels of such increased capabilities should be adopted, as will render them fully adequate to the difficulties of the Cape navigation. In this view of the case, vessels of the burden of 1400 or 1500 tons, and proportionate power, are probably the best: they must be maintained, it is true, at a considerably increased expense, and will probably be less profitable than the smaller vessels, but they certainly must lend a confidence to the enterprise it could not otherwise possess; and, while rendering the maintenance of an Oriental steam communication independent of any embarrassing vicissitudes in the affairs of Egypt which may arise, although they cannot now be foreseen, must in the mean time secure more favourable terms for the transit through that country, by making this independence so visible. These, indeed, are advantages reaped not by the persons by whom a steam communication may be kept up, but by the country at large; and as they are purchased at a considerably increased expenditure, they ought to meet with a correspondingly increased recompense.

Any line of steam communication between Great Britain and India, to be effectual and satisfactory, must necessarily extend to the three presidencies. The difficulty of inland travelling in India is so great, that a steamer starting from Bombay would get scarce any passengers from Calcutta or Madras. They would prefer the dreary passage by the Cape, in a sailing vessel starting direct from those places, to a steam voyage which had necessarily to be preceded by the perils and privations of a long land journey. In the whole of India there is scarcely a single road which can properly be called by that name. In the rainy season the rivers are impassable; and at other times of the year, the excessive heat renders travelling of any kind almost impossible, except at night. Travellers are sometimes attacked by robbers, or devoured by tigers; and in no part of the country are there suitable inns, or other places of accommodation. A steam intercourse, therefore, between any one of the presidencies and Great Britain, would afford scarce any accommodation to the other two; and, while the expense would be nearly as great as if the three presidencies were included, the revenue would be widely different. Any scheme, then, pretending to maintain a steam communication between Great Britain and one part of India only, would necessarily be very unprofitable, and would fail to satisfy the desires and expectations of the Indian people.

Before entering upon the consideration of the proper distribution of the various lines of Oriental intercommunication, it is necessary to advert to some of the atmospheric peculiarities of the Indian seas. The monsoons are two great atmospheric currents, which alternately prevail at different seasons over the Indian Ocean and Bay of Bengal. The north-east monsoon continues to blow from the autumn to the spring; and the south-west monsoon from the spring to the autumn. The force of the north-east monsoon is not sufficient to offer any serious obstruction to the progress of a steam-vessel; but the south-west monsoon, during the time which intervenes between the middle of June to the middle of September, blows with such violence, that it is supposed, by many nautical men, a steamer could not advantageously contend against it. The prevailing direction of this wind is nearly W.S.W., and is therefore nearly in direct opposition to the course of a steamer proceeding from Bombay to the Red Sea; and it has been questioned whether a steamer of ordinary dimensions could carry sufficient coal to propel her through the distance between Bombay and the mouth of the Red Sea, against so serious a resistance. We do not apprehend any difficulty on this score; but it is right that we should furnish our readers with Dr. Lardner's opinion.

> “ To determine the practicability of accomplishing the passage from Bombay to Suez during the monsoon, it will be necessary to consider the limit which is imposed on the length of the trip, by the power of the vessel to carry fuel. The Admiralty steamers between Falmouth and the Mediterranean, which are by no means the most efficient steam-ships, are capable of carrying 1¼ ton of coals per horse-power; but the larger class of steam-vessels, such as the *Medea*, the *Rhadamanthus*, the *Dee*, and others, would, if disencumbered of their guns, carry about 1½ ton per horse-power, without being materially affected in their trim. Now I have found, from an investigation of the performance of the frigate *Medea* for above 10,000 miles, that, in average weather, a ton of coals per horse-power will carry her a distance of above 2000 miles; a ton and a half would, therefore, carry her a distance of 3000 miles. Let us suppose, then, the *Medea* stationed at Bombay, and attempting the passage to Socotra in the monsoon: she would carry fuel for a voyage, in average weather, of 3000 miles, having only 1200 miles before her. Supposing, then, her speed against the monsoon to be less than her average speed in the proportion of 1200 to 3000, or of 2 to 5, she would still have fuel sufficient to accomplish the passage. The average rate of the *Medea*, derived from 10,000 miles of her performance, I have found to be about 8 miles an hour: if, therefore, by the force of the monsoon, her rate were reduced to 3½ miles an hour, the accomplishment of the passage would be practicable.”

This deduction involves the supposition that the quantity of coals consumed per hour, at this low rate of speed, would be the same as at the ordinary speed with which the vessel was propelled, and also that the monsoon blows with its full force, without subsidence or intermission. Both of these suppositions, however, are untenable; and the consumption of fuel would be greatly less, and the average speed considerably more, than the rates Dr. Lardner has assumed. The consumption of fuel, moreover, by steam-engines, has been considerably reduced since 1837, while, at the same time, a higher rate of speed has been attained. We, therefore, do not anticipate any difficulty in the accomplishment of the voyage from Bombay to the Red Sea, against the monsoon, by vessels of 800 or 900 tons burden, and adequate power, if constructed with a due regard to the difficulties of that navigation. The working pressure of steam in the boilers should be not less than 8lbs. or 9lbs. per square inch: the paddles should be placed well forward in the vessel, and the floats should be large, and have a deep dip. There should be a mizen-mast of an efficient description, so that the vessel's head might be kept up to the wind; and the proper trim of the ship should be carefully preserved. By a regard to these precautions, the passage between Bombay and the Red Sea might be performed at all seasons of the year, and the necessity obviated of sending the Bombay steamer down the coast to Ceylon, to meet there the steamer from Calcutta. In Dr. Lardner's views on this subject we perfectly concur; and we shall here recapitulate them for the benefit of the unbelieving.

"In the investigation which took place on this subject before the committee of the House of Commons, in 1834, it was admitted by the nautical authorities most opposed to the project, that the passage from Bombay to Socotra, during the monsoon, was *practicable;* but it was denied that it could be permanently profitable. It was contended, that by facing the monsoon for a continuance, the vessel and machinery would be subject to such rapid wear, and the consumption of fuel would be so great, in proportion to the distance travelled over, that the expense would be enormously disproportionate to the advantage. In this opinion I agree, if it be meant that those voyages made against the monsoon, and *no others*, are considered. These voyages, unquestionably, would be attended with considerable expense; but it is to be remembered that, in a monthly communication, there will be twenty-four passages in the year between Bombay and Socotra; three of which only, or at the most four, will be subject to this objection. The question therefore is, whether the extra expense of these passages, being only an eighth, or at most a sixth of the whole annual performance of a steamer, would be disproportionate to the advantage of maintaining an unbroken monthly communication.

"In considering the objections depending on the south-west monsoon, all parties concerned in the inquiry appear to have forgotten to take into account the benefits which, on the other hand, will be derived from it. During this monsoon, if efficient ships be provided for the purpose, the passages from Socotra to Bombay will be made under sail only: the fuel, therefore, appropriated to the passages *with* the monsoon, will be altogether saved, besides a corresponding proportion of the wear and tear of the machinery. This item will go far to counterbalance the disadvantages which have been so magnified on the other side."

We have lingered too long, we fear, among these details, and must now proceed to the more prominent features of the scheme by which a satisfactory and profitable steam communication may be maintained with all the Indian presidencies. Steamers of about 1500 tons burthen, and about 450 or 500 horses-power, are, we have already stated, upon the whole to be preferred; and we would make Cosseir, instead of Suez, the port of departure from the India side of Egypt. Passengers proceeding to India would thus, on their arrival in Egypt, proceed up the Nile as far as Kennah; from which place there is a good road to Cosseir, and which has the great advantage of being well supplied with water. Travellers would thus have an opportunity of inspecting the stupendous remains of antiquity with which Egypt is adorned, without a sojourn in the country for that particular purpose; and an agreeable variety would be introduced, by the exchange of a few hundred miles of river for sea navigation. The intricate navigation of the Straits of Jubal would thus also be avoided, and the necessity obviated of taking in coals at the upper part of the Red Sea. The expense of coal in all the more northerly ports of the Red Sea, is enormous; they lie quite out of the track of sailing vessels; and the Shumaul wind, which blows down the Red Sea for eleven months out of the twelve, prevents the access of sailing vessels towards its upper extremity; while the southerly winds which prevail about the Straits of Babelmandeb, and as far north, indeed, as Juddah, makes it difficult for a sailing vessel which has once got into the Red Sea, to get out again. Arab vessels, indeed, by keeping within the reefs with which the coasts are fringed, are able to take advantage of the variable winds which are to be found close to the shore; but European vessels require to keep the mid channel, and there the peculiar character of the prevailing winds gives rise to serious embarrassment. It is extremely important, therefore, to supersede the necessity of taking in coal on the Red Sea side of the Egyptian terminus; and by making Cosseir the terminus, instead of Suez, a sufficient supply of coal might, we think, under ordinary circumstances of wind and water, be taken in at the mouth of the Red Sea, to accomplish the desired object.

Aden is the port at which steam-vessels now call for relays of fuel; but we think the Island of Perim, in the middle of the Straits of Babelmandeb, would be a preferable place for a coal depôt, on many accounts. In the first place, its geographical position is preferable, if Cosseir be made the Egyptian terminus—the distance from Ceylon to Perim being nearly the same as the distance from Perim to Cosseir, and back. After leaving Calcutta, therefore, the steamer would take in coal at Ceylon and Perim only. Madras should not, we conceive, by any means be relied upon as a depôt; for at sundry times, and especially at the monsoon gales, it is unapproachable; and, even under less inauspicious circumstances, it would be always difficult, and often impossible, to get coals put on board. Another great advantage of Perim, as a depôt, is the circumstance of its being an island; by which peculiarity, it would be less subject to the incursions of barbarian hordes. Its harbour is excellent, and is easily approachable by sailing ships at every season. It labours, indeed, under the disadvantage of a want of water; but it is probable enough that water would be found if wells were dug; and, should this not be the case, it would be easy to obtain a supply of water for all the residents that would be necessary, by distilling the water of the sea.

Galle is, we think, the best port in Ceylon for a coaling station, if reference be had merely to the Indian line; but if steam voyaging be extended, as it of course will be, to China, Java, and New South Wales, Ceylon must become the terminus of several important lines; and, with this anticipation before us, Trincomalee appears, in our judgment, the preferable station. The China and Australian vessels will of course require repairs, which must be executed upon the spot; and Trincomalee is the only Ceylonese port which possesses any facilities for the repair of either engines or ships.

The merchandize carried between India and England by steam-vessels, must of course be restricted to small and valuable articles; but we believe that a large proportion of such articles as the following will be sent to India by every steamer:—Bullion, law papers, periodicals, samples, military accoutrements, millinery, jewellery, tinsels, glass, quicksilver, fine bale goods, books, &c. The return articles will be bullion, samples, small parcels, pearls, diamonds, and other precious stones, musk, otto of roses, tortoiseshell, cashmere shawls, raw and wrought silk, camphor, shell-lac, cinnamon, cloves, and other spices, nutgalls, indigo, &c. The greater number of the passengers to and from the East will, we have no doubt, avail themselves of the Red Sea route, so soon as it shall have been fully opened up, and made to comprehend the three presidencies; and the increased facilities of transit will induce many to travel, who would otherwise remain at home. The Red Sea route will not only, therefore, obtain a large proportion of the existing passengers to and from India, but the total number of passengers will be prodigiously increased, and the main stream of intercourse will be still farther swelled by the tributary lines of China and Australia. Upon this subject, however, we must make room for Dr. Lardner's exposition.

"It is utterly at variance with every analogy derived from experience, to suppose that the increased expedition would produce no corresponding increase of intercourse. If the substitution of steamers for sailing vessels have increased in a tenfold proportion the intercourse between Great Britain and the continent of Europe; if the substitution of locomotive engines on a railway, at 30 miles an hour, have increased the intercourse between places so easy of reciprocal access, under any circumstances, as Manchester and Liverpool, Newcastle and Carlisle, Dublin and Kingston, &c., in a fourfold proportion; is it reasonable or probable that the intercourse between Great Britain and the greatest of her dependencies, now as far removed as pole from pole; between families and kindred heretofore separated by a barrier, deemed for all social purposes all but impassable, between a mother country in the full pride of wealth, and in the meridian of civilization, and her distant children aspiring to her arts and sciences, and gasping for knowledge;—is it, I repeat, reasonable or probable, on any ground on which inference may be raised, that, in such a case, the shortening of the distance from sixteen thousand miles to six thousand; the shortening of the time from four or five months to six or seven weeks; the subjugation of the powers of wind and water, by the omnipotence of the greatest mechanical agent which science has ever presented to art—that these and innumerable other inducements, which crowd upon the mind, when the two routes are considered, would not cause an enormously increased intercourse with home? It may not do so. The event may contradict my anticipations. Our friends and relatives in India may love the weary waste of the Atlantic, and court the dangers of the southern ocean: they may love the scorching sun of the tropics so much as to go sixteen thousand miles round, for the pure pleasure of twice crossing the line; they may prefer to be confined to their wooden prisons for four or five months, to a release at the end of a few weeks;—this may all happen, and the steamships may be left to carry despatches, and a few curious and eccentric adventurers; but, if such be the event, I can only say that a more signal instance of a violation of all that analogy and uniformity, by which the conduct of masses of people has been heretofore observed to be governed, cannot be produced in the whole history of the human race."

These arguments are, in our eyes, sound and irresistible; and cannot fail, we think, to carry conviction even to the greatest sceptic, that the number of Indian passengers must be prodigiously increased by a steam communication. Of this increased number, too, the steamers must, we think, carry such a large proportion as to make the steam enterprise profitable and enduring. But these prospects, however brilliant, are dim and insignificant in comparison with the splendour of the promise involved in the inevitable extension of a steam intercourse to every part of the East, and which only awaits the completion of the main stem, to spring into immediate maturity. The communication between Great Britain and her Indian possessions, though of course extremely great, constitutes but a moderate proportion of the total intercourse between the Eastern and Western worlds; and a glance at the map is sufficient, we conceive, to show that so soon as an efficient line of steamers shall have been established between England and the several Indian presidencies by the Red Sea, that route must become the channel in which the best of the oriental commerce of Europe will necessarily circulate. It is not for India merely that these vessels must carry passengers and merchandize, but for Australia, Sincapore, Java, China, Japan; and, in short, every country of the East. To all of those places lines either of moderately-sized steamers or fast-sailing packets, will inevitably be carried from Ceylon so soon as an articulated line of communication with England shall have been fully established; and these tributary lines will swell the volume of the main stream of intercourse until it exceeds, perhaps, any limits which the most heated imagination could now venture to assign.

Such are the anticipations relative to oriental steam voyaging which it appears to us naturally flow from a careful consideration of the subject. Those of our readers who may dissent from our conclusions will find a safer ground for their faith in the declarations of Experience; and to that unerring and inaccessible judge we willingly leave the determination of the question.

The Peninsular and Oriental Steam Company has now been established, we believe, about two years; and, with only two vessels plying between England and Alexandria, and no vessel at all on the other side of the Isthmus of Suez, has paid the shareholders, from the very first, a dividend of 7 per cent., besides discharging every expense of the undertaking, and laying up a large sinking-fund to cover the deterioration of the vessels. The profits, moreover, have exhibited a gradual and steady increase, in spite of the unprecedented depression under which commerce of every kind has latterly laboured. These results are, we think, conclusive,—the rate of profit being sufficiently encouraging even if trade were never to revive, and no increased communication were to follow the completion of the line. But, can any one soberly anticipate the likelihood of such contingencies? Can any one conceive that the vessels between England and Alexandria must not carry more passengers so soon as vessels of equal goodness shall have been established between Egypt and India? or that many who have been heretofore deterred by the difficulties of the Egyptian transit, the inadequate accommodation of the Red Sea steamers, and the necessity of journeying from one Indian presidency to another before embarking, will not avail themselves of this route so soon as these objections shall have been completely eliminated? And if a greater number of passengers are carried, must not the profits of the enterprise increase, and the dividends necessarily rise? The expense, indeed, of steam voyaging in the Red Sea is greater than in the Mediterranean; but the charge for transport is greater in the same proportion: so that the whole question resolves itself, whether more passengers will not be carried when the disjointed and unsatisfactory arrangements heretofore in use shall have been supplanted by a continuous and efficient communication? This improvement is now about to be carried into effect. The *Hindostan*, a steamer of 1800 tons, and 550 horses-power, has been sent by the Peninsular and Oriental Company to ply between Suez and Calcutta, calling at Madras and Ceylon; and has, we suppose, before this time, completed her first voyage. The *Bentinck*, another steamer of the same size and power, we see it announced, is speedily to follow; and these two vessels, on the Indian side of Egypt, in conjunction with the *Great Liverpool* and *Oriental* on the European side, will maintain a continuous monthly steam intercourse between Great Britain and India; and passengers may take their places at either end for the whole distance. By thus bringing the whole line under one management, a harmony and efficiency will, we conceive, be given to all the arrangements, such as might be sought in vain by any other expedient; and the party by whom the intercourse is maintained has an obvious and sufficing incentive to improve the means of transit through Egypt to the utmost. The efficacy of these inducements has already been made apparent: a continuous steam communication between Alexandria and Cairo has been established recently; hotels have sprung up in the desert, furnished with every European comfort; and the route through Egypt is, in fact, on the point of becoming the most pleasant part of an Indian voyage. By the plan of taking their places for the *whole distance*, passengers are relieved of all perplexity about getting from Suez to Alexandria in time for the departing steamer, as well as of all anxiety respecting the safe transport of their baggage. For the fulfilment of both of these conditions, the party which has undertaken to convey them is responsible; and the traveller may thus surrender himself to the contemplation of the wonders of that mysterious country through which he is passing, and which has continued to be an object of curiosity to countless succeeding generations. There is no civilized people to whom Egypt is not full of the deepest interest: she is revered as the parent of arts, and the nurse of civilization; and many of the events of her history are interwoven with our most exalted associations. Then there are all the images which her monuments of antient magnificence inevitably call up in the mind of the spectator—the gorgeous pageants of her kings, and the combats and triumphs of her warriors, contrasted with the stillness and desolation which now reign around their graves; and the involuntary awe inspired by the recollection of her mystic superstitions, and their cruel rites and abominations, at once heightened and redeemed by the extraordinary attainments of her priesthood. Add to this, the solemn emotions called up by the spectacle of those imperishable piles which record the ambition of forgotten potentates, and the touching reflection perpetually returning of the vanity of all our toils and ambition, when generation after generation thus passes away into oblivion, and Time blots out their names from the page of history in spite of all the eternal monuments which have been so vainly reared to perpetuate them.

We do not pretend that emotions such as these will arise universally out of the spectacle of the magnificent ruins with which Egypt is adorned; yet we think they will be exceedingly general, and are the natural growth of minds of ordinary sensibility. We think, too, that the anticipation of seeing these far-famed remains will constitute an additional reason, with the generality of travellers, for preferring a route to India by the Red Sea; and will, indeed, ultimately draw numerous visitors to Egypt for this sole object. To persons of a cold and coarse imagination, such a motive for visiting a distant country will no doubt appear unintelligible; yet if the works of art for which Italy is famous draw crowds of enthusiastic admirers,—if even the desolate sites of Delphi and Lacedemon have their pilgrims, which come up from afar to worship at their imaginary shrines, shall Egypt be neglected, whose antiquities appeal to far holier sympathies, and conduct the imagination to a far earlier age? Nor can the unequalled magnitude of the Egyptian temples—their stupendous proportions, and surpassing difficulty of execution, fail to exercise a powerful influence on the minds of most spectators, independently of all more subtle or remote associations: and Italy may at no distant period be neglected, and her puny graces grow pale and ineffectual before the austere grandeur and awe-inspiring majesty of the giant constructions of the Pharaohs.

It is only, of course, among European travellers that motives such as these can be supposed to have much influence. With the natives of India, we do not think they would have the least weight; and the increased estimate of Egyptian transit, due to this cause, whatever be its amount, must therefore be restricted to the case of Europeans. To a large proportion, however, of our Indian population, the holy city of Mecca, situated near the middle of the Red Sea, presents a most powerful object of attraction, and a vast number of persons will, we believe, avail themselves of a steam communication to perform a pilgrimage to that place. Many of the natives of India, who have thus come half the way to England, will afterwards come the remainder of the distance; and indeed, there appears to be a growing disposition on the part of the richer Indians of every denomination to visit this country;—a disposition, the recent visit of a most accomplished Indian gentleman to our shores, and the distinguished reception he met with, are, we think, materially calculated to increase. We cannot afford, however, to dwell longer in the enumeration of elements of promise such as these, and indeed any such catalogue is unnecessary for our present purpose, which is merely to show that Dr. Lardner's predictions relative to Oriental steam voyaging have been quite as accurately fulfilled as in the case of the Atlantic enterprize. While Atlantic steam voyaging, instead of paying dividends to the proprietors, has been a source only of ruin and disgrace, and has already died into insignificance, Oriental steam voyaging has paid from the beginning a dividend of seven per cent. though labouring under the evils of a broken chain of intercourse and numerous other discouragements, and is fast rising to that giant stature and high renown which appear to be its inevitable destiny.

There is one anomaly connected with the financial administration of the company by which the intercourse by steam between India and Great Britain is maintained, to which we feel it necessary to advert. Notwithstanding the profits and promise of the undertaking, the shares, we understand, are not at a premium; and some persons have, we believe, hence inferred that the past success of the enterprize is not due to any intrinsic elements of prosperity, but is accidental merely to a greater skill and economy in its management than fall to the lot of other undertakings, and which of course are uncertain conditions. This argument might have some weight, if the best management in the world could turn a bad scheme into a good one; but it is manifest, that though an excellent enterprize may be spoiled by mismanagement, no management, however admirable, can ever work the redemption of a radically vicious project. The very vessels which have maintained so beneficial an intercourse with Alexandria for the last two years are some of those which attempted the maintenance of a steam communication between Great Britain and New York; yet, from this last station they were driven with immense loss in the course of a single season, though managed quite as skilfully as they have subsequently been. Another reason which we have heard assigned for the absence of any premium on the shares is, that the dividends are fictitious—that they are derived, not from the *bona fide* profits of the vessels, but from the division of the capital of the company. This is a very serious charge; we have, therefore, felt it our duty to examine it minutely, and are enabled to say that it is without the slightest foundation. The imputation, indeed, is sufficiently incredible, and, we might add, carries its own refutation. It is impossible to suppose that the names the directory of this company numbers would lend themselves to a fraudulent transaction, and we do not find that the charge has obtained any credit among the share-holders or other persons of respectability. Indeed, it appears impossible that any one in the least acquainted with the circumstances of this corporation could entertain such an idea for a moment; its published official documents, not only show what the amount of the profits actually are, but how they have been derived; and the more important of those documents are such as it must be impossible to falsify. These considerations are of themselves sufficient, even if it were not abundantly evident that no two vessels *could* have continued to ply year after year with good dividends and increasing profits, if the capital this income represents had been all the time rapidly diminishing.—The absence of a premium upon these shares is, it appears to us, due to various causes, of which there are three more conspicuous than the rest.

In the first place, then, steam property of every description has been for some years past labouring under a great depression; partly in consequence of a universal commercial stagnation, but chiefly, no doubt, from the imperfect success of numerous steam enterprizes. A discredit is thus thrown upon steam enterprizes in general, and the failure of a bad scheme in steam navigation as certainly damages a good one, as the failure of a bank or two in a particular district causes all the banks in the neighbourhood to be suspected. The natural tendency of such a state of things is, we think, to lower the prices of shares or prevent them from rising, and this tendency will be more active in the case of a new undertaking at the same time that its activity will be less visible. This, however, is a source of depression which extends to all steam enterprizes, but there are others which apply to this undertaking exclusively. The effect of the failure of the Atlantic steam enterprizes was to cast a serious doubt upon every undertaking which involved the employment of great steam-vessels and pretended to maintain a steam intercourse with distant countries. Nothing, it is true, can be more widely different than Atlantic and Oriental voyaging; and the prospects of every steam enterprize are only to be ascertained by a reference to the specific circumstances which attend it: but into such circumstances, the larger proportion of the persons holding shares in joint stock companies are unable to enter, and their judgments will generally be swayed, rather by the most prominent considerations, than the most relevant ones. The blame of the unsatisfactory issue of the Atlantic project was put upon the large vessels which it had been necessary to employ, and a very general impression therefore arose that large steamers would not do. But the Oriental project involved the employment of large steamers, and had one of its termini in a distant land, therefore it was concluded that the Oriental project would not answer;—the examination of those peculiarities of the enterprise, upon which success or failure necessarily hang, being of course looked upon as superfluous. Add to all this, the serious shock which the confidence even of the most believing has sustained from the maladministration of the West India Mail Company, and which must, we conceive, have operated upon the Oriental Company most prejudicially. The two establishments, indeed, are often confounded, and distant or unskilful observers are unable to conceive how the East India Mail Company can be successful when the West India Mail Company has been so disastrous a failure. The purposes, denominations, and other outward resemblances of these two undertakings call up in ordinary minds impressions of similarity, though in all essential points none really subsists; and it cannot, we think, be doubted that such analogies, however vain and fanciful, must damage the Oriental project in the public opinion. Of the public opinion, the price of the shares is the natural exponent; and, therefore, to say that the shares are not at a premium, is merely to say, that the extraordinary combination of circumstances we have mentioned has had some influence over uninformed persons. In our eyes, the only marvel is, that this influence has not been greater; and taking into account the revulsion due to the disappointment of extravagant hopes relative to steam enterprise, and the excesses into which popular opinion generally runs, we are surprised that the shares of any undertaking, which can be linked with the exploded projects by even the most visionary association, should be capable of maintaining their value; and in this case, that event is due altogether, we conceive, to the strong confidence of discriminating judges in the eligibility of the undertaking and in the skill and honesty of its management. If the West India Mail Company were only put out of pain, instead of dragging on a miserable existence, the Oriental Company would, we believe, speedily feel the benefits of that act of benevolence, and the price of its shares would rise; but we do not anticipate that the shares of the Oriental Company will reach any high premium so long as a great Atlantic scheme remains to parody its proceedings.

So far, our observations have had reference to Oriental steam voyaging viewed merely as a commercial enterprise; but it has other and even higher claims to consideration; and the most competent authorities have declared that its social and political effects must be so important that they would be cheaply purchased at almost any price. Of this, indeed, the Governments both of England and India seem to be sufficiently sensible; and they have given all possible encouragement to the undertaking. The East India Company, in particular, has acted with a prompt liberality, in promoting the improved communication, which shows the injustice of the stigma at one time cast upon it, of being hostile to a steam intercourse, and which we sincerely believe is calculated to be productive of the most important advantages in many ways. It is very certain that no measure was ever more popular throughout every part of the East, whether among the natives or Europeans; and the effective part the East India Company has taken, in securing for its subjects this coveted boon, will inspire a deep and universal gratitude. The Peninsular and Oriental Company has, we understand, received a grant of £20,000 per annum from the East India Company for a period of five years, to commence from the time of their placing the first vessel on the line between Calcutta and Suez; and without any other condition than that, within three years, a continuous monthly communication shall be established. The East India Company has, moreover, afforded most important facilities in the way of coals, repairs, &c., at the several stations, and has manifested an anxiety to promote in every way the success and efficiency of the undertaking. The collateral advantages of a steam communication with India are very ably shown forth in a pamphlet upon that subject, now lying before us, in the following extract:—

"Political objects are not less manifest in the necessity of making available the accelerating power of steam in the means of communication with India. The vast extent of country—the various degrees of confidence and distrust—of affection or concealed hatred—of enlightened and enlarged views or narrow and irremovable prejudices—and of ambition or fears of the several chiefs or nobles of the subdued nations which form the Indian empire of Great Britain —(a heterogeneous mass requiring constant watching, and the power of the immediate application of a remedy in case of any disturbance of that conventional harmony so essential to the continuance of British supremacy:) all these considerations call for the establishment of as rapid a communication with the chief seat of government as the ingenuity of man can devise and as the acuteness of a wise government can adopt. When, therefore, so many imperious demands start up to appeal to the energies and power of a great community like the British public, they become irresistible and must prevail."

In spite, however, of these very obvious considerations, there are a few we believe among the less perspicacious of our India proprietors, who apprehend that a steam intercourse must add greatly to the labours of the East India executive, by bringing a vast number of appeals and complainants to this country. Such, indeed, may be supposed to be its effect, if at any time, the tyrannies of the Company's servants in India become insupportable, and this in fact, is one of the cardinal advantages of the plan: for the security of our empire must be wonderfully increased, by affording discontent a means of escape, before it has reached any dangerous elasticity. In this opinion, such of our readers will probably concur, as agree with us, in thinking that the greatest danger our Oriental dominion has to apprehend is the growth of a sullen, and secret disaffection, and an improved intercourse with England will abate the dangers of so destructive a spirit, both by affording it scope, and vent, and by strengthening the political fabric with new bonds of loyalty and attachment.

We are unable to pursue such considerations further, and must here close these loose and miscellaneous observations, in which it has rather been our purpose to show that Dr. Lardner's predictions relative to Oriental steam voyaging have been fully borne out by experience, than to enter upon the details of any particular plan. And we would put the question seriously to those who have taken the trouble of following us, whether a coincidence so singular between theory and practice can be supposed to be merely accidental? Whether of two opposite predictions, both of which have been fulfilled to the letter,—which were based on computations no one has been able to confute, and are verified by facts no one is able to deny,—we can only conclude that they were visionary and fallacious, and that any agreement they may manifest with the event is the achievement merely of a blind fatality? The supposition is manifestly impossible. And what, then, shall we say of the heavy vituperation which has been poured upon Dr. Lardner on account of his alleged errors on these subjects?—We leave the answer to this question to the hearts and consciences of all wise and honourable men.

Explanation of the Map.

The courses marked on the map are those which we think the best, and have no reference to those adopted by any particular vessels. The steamer upon leaving the Sand-heads at the mouth of the Hooghly would steer direct for Cape Palmyras, from whence she would hold her way down the coast to Madras. We do not propose that coal should, under ordinary circumstances, be taken in at Madras, but the vessel, after communicating with Madras, would proceed to Trincomalee, in the island of Ceylon, where she would take on board a sufficiency of coal to carry her to the mouth of the Red Sea. On leaving Ceylon she would keep to the southward and westward, so as to avoid the heavy sea which runs round Point de Galle at particular seasons, and so to get so far to the westward as to be able to make direct for Cape Guardafui, at the mouth of the Gulf of Aden, keeping to the westward of the Maldives. By this arrangement the vessel would be able to carry sail all the way from Ceylon to the mouth of the Red Sea, during both monsoons.

The Red Sea coal depôt we have already stated should, we think, be Perim, an island situated in the middle of the Straits of Babelmandeb. At this place the steamer should take in a sufficient supply of fuel to carry her to Cosseir and back. The enormous expense of transporting coal to the upper parts of the Red Sea, which are almost inaccessible to sailing vessels, would thus be saved; and vessels bound for Mocha, which is close to Perim, would, we think, be happy to transport coals thither at a very moderate rate of freight. The vessel from Bombay would meet the Calcutta vessel at Perim: on leaving Bombay, she should steer for Point Kisseen, a little to the eastward of Maculla, and then keep along the Arabian coast until she reached the straits of Babelmandeb.

On looking back upon what we have written, we do not see that we have anything very material to amend. We must remark, however, that the route by Cosseir and Kennah, though the most interesting one, certainly occupies more time than that by Cairo and Suez, as well on account of the convolutions of the Nile, as of the increased resistance occasioned by its current.

We may also add, that, the probability of this route to India being ever closed is very remote indeed. The present Pacha of Egypt has given substantial proofs of his desire to encourage the transit, fully aware of its benefits to the country and himself. He has freely granted Firmans to the Oriental Company, to navigate the Nile, as well as the great canal of Alexandria with steam boats, in order to facilitate the transit of passengers and goods; and has abolished the high transit duty of 3 per cent., *ad valorem*, leviable under the treaties of the Porte. And should war even with the Porte hereafter break out, England's first step would no doubt be to possess herself of Egypt.

Art. II.—GRAND JUNCTION LOCOMOTIVES.

Specification for six-wheeled Passenger Engines, with 13 *inch cylinders;* 18 *inches stroke;* 5 *feet driving-wheels; leading and foot-plate ditto,* 3*ft.* 6*in.*

Boiler—To be cylindrical, 8ft. 6in. long, including tube-plates; 3ft. 6in. diameter outside, and made of the best Lowmoor plates, ⅜in. thick, laid lengthways of boiler, and well riveted together; fixed to fire and smoke-boxes with extra strong angle iron 2½in. wide, and a single row of rivets for the upper half, and 3in. wide for the lower, with a double row of rivets. Six longitudinal iron stays to pass through boiler, connecting tube-plate at chimney with fire-box. These stays, 1in. diameter at the fire-box, to be attached to a strong piece of angle iron, riveted to the fire-box plate, and at the chimney end to be tapped and screwed into the tube-plate, and made secure with lock-nuts. The tube-plate at chimney end must also be made of the best Lowmoor iron ⅝in. thick, and be provided with a mud-hole and door in place of two tubes in the bottom row.

Outside Fire-box—Also of best Lowmoor plates, ⅜in. thick; a wrought-iron dome, 20in. diameter inside, with circular top, to be placed on it; this dome is to be bolted with $\frac{3}{4}$ bolts, 3 inches asunder, to a wrought-iron or brass ring riveted to boiler with $\frac{5}{8}$ rivets; the upper surface of which ring, as also the flanche at bottom of dome, to be turned perfectly true, and ground together, so as only to require a little red-lead to make a steam-tight joint. An oval fire-door, 12in. × 10in., with chain attached. The angles of fire-box, at the bottom, to be rounded with a radius of 3 inches, and an oval mud-hole to be placed at each corner, with a joint made inside. The bottom of fire-box, when the engine is in working order, must be 20 inches from the rail. Ash-pan to be made of best Staffordshire iron plate, $\frac{5}{16}$in. thick, with close back; the bottom of pan to be made of iron bars $1\frac{1}{2} \times \frac{5}{8}$in.; this pan to be hung to fire-box with four hinges, and to fit close at both sides and end with a jump-joint, and to be provided with a door under the foot-plate, for the purpose of raking out the ashes.

Inside Fire-box—To be made of the best copper plate $\frac{7}{16}$in. thick, except the tube-plate, which must be $\frac{3}{4}$. The roof to be well stiffened with six wrought-iron stays, arched, and resting on the upright plates. The water space between inner and outer boxes at bottom, to be fitted up with strong double angle iron; also at fire-door, with a wrought-iron ring $2\frac{1}{2}$in. wide, and 3in. deep; this ring to be faced on both sides. The outer and inner boxes to be stayed together with the best iron stays $\frac{7}{8}$in. diameter, and 4in. apart from centre to centre; these stays to be tapped and screwed into both plates, and well riveted at each end.

Smoke-box—Also made of best Lowmoor iron, $\frac{3}{8}$in. thick, except the plate to which the cylinders are attached, which must be $\frac{1}{2}$in. thick; the length of it to be 2ft. $1\frac{1}{2}$in. inside dimensions. Chimney to be 13in. diameter outside, and 13ft. high from the rails to the top of wire cap, and made of a single plate $\frac{1}{8}$in. thick, the seam-plate being inside.

Tubes—109 in number; 2in. diameter outside, and No. 14 wire-gauge; to be made of the Cheadle or Basley Company's best sheet brass, with cap-joints, and soldered inside. The tubes to be placed $\frac{7}{8}$in. apart, to have $\frac{3}{8}$in. cap at each plate, and properly fastened with steel ferules; the ferules at smoke-box end to be wider at the box than those at the fire-box.

Outside Framing—To be made of well-seasoned ash. 8in. deep × $2\frac{7}{8}$; 6ft. across from centre to centre, plated on both sides with best plates $\frac{5}{16}$in. thick. Buffer-plank to be 16in. deep, and 5in. thick, also of ash, connected to frame by strong iron knees; that part of it which projects below the frame, to be strengthened by a wrought-iron bracket, with a joggle let into the frame so as to take off the strain from the boiler. This plank to be provided with two 15in. diameter leather buffers, each stuffed with three horse-hair pads, also with a chain and hook in the centre, with a wrought-iron washer inside, 12in. × $10\frac{3}{4}$in. The foot-plate to be well bolted to framing, and resting on a piece of angle iron, which must be riveted to the fire-box. The draw-bar frame to be constructed according to the common method. The usual centre connexion between engine and tender to be provided, and additional eye-bolts, with shackles and chains, to be fixed to draw-bar frame for additional security in coupling engine and tender.

Axle-guards—To be made of best plates, $\frac{1}{2}$in. thick, all of the same length.

Axle-boxes—To be made of cast-iron, having loose brass steps accurately to fit into them; for the crank-axle, to be 11in. deep; and for the others, to be 10in. deep.

Inside Framing.—Two inside frames, of the best iron. They are to be placed between the wheels and cranks, and to be firmly secured to each other, and the outside frame by a cross plate $\frac{5}{8}$in. thick, also of best iron, to which the ends of the slide-bars must be attached.

Cylinders—Made and fixed precisely according to the directions given, and to be furnished with the necessary cocks, handles, &c., &c.

Slide Valves—To be of brass, and worked by four eccentrics, pistons, cross-heads, and connecting rods, in the best manner.

Wheels.—Each engine to have six wrought-iron wheels, with cast naves; the drawing ones 5ft. diameter, having areas, each of which must be $2\frac{1}{2} \times 1\frac{1}{2}$ at the nave, and $2\frac{1}{4} \times \frac{7}{8}$ at the rim. All the spokes must be welded, not riveted, to the inner tyre, which, when turned up, must, for the larger wheels, be 5 × 1, and for the smaller $5 \times \frac{7}{8}$. The naves for large wheels should be 16in. diameter × 7in. thick, bored out to $6\frac{1}{4}$; and, for the others, 5in. diameter, 7in. thick, bored out to $6\frac{1}{4}$; and for the remainder, 5in. diameter, 7in. thick, bored out to $5\frac{1}{4}$; each boss to be hooped with two wrought-iron hoops $\frac{1}{4}$in. deep × 1in. wide; all the tyres to be made of best Bowling hammered iron, 5in. wide, 2in. thick, when turned. Before the tyre is shrunk into the wheel, the inside of it must be properly bored out, and the iron of wheel turned. One conical bolt to be fixed in each second space, driven from the outside to assist in keeping the tyre on the wheel, and riveted inside. Each wheel must fit tight on to the axle, and be keyed on with four steel keys 1in. wide, $\frac{3}{4}$in. thick; all the wheels to be accurately turned up after they are permanently keyed on to the axles; a template, which must be most strictly worked to the exact diameter, shape, and situation of the wheels, will be furnished by the Company.

Axles.—All the axles to be made of the best scrap-iron, according to templates furnished by the Company. The crank-axle to have 4in. diameter outside bearings; $5\frac{1}{2}$ inside bearings and crank-pin; $6\frac{1}{4}$ part on which wheels are to be staked; $5\frac{1}{2}$ for eccentrics. Front axle, 5in. diameter in the centre; $5\frac{1}{4}$ in the wheel-seats, and 4in. outside bearings. Foot-plate axle, $4\frac{1}{2}$in. diameter in the centre; $5\frac{1}{4}$in. at wheel-seats; and also 4in. diameter outside bearings. The two inner, as well as the two outer bearings of crank-axle, to be supported on springs 2ft. 4in. long, and made of fourteen plates, $3\frac{1}{4}$in. wide. Those for the outer bearings, the same dimensions, as the weight on the driving-wheels is to be equally borne by these four springs. The front springs are to be 2ft. 6in. long, and made of sixteen plates, $3\frac{1}{4}$in. wide; those for the hind axles the same length. Fourteen plates, $3\frac{1}{4}$in. wide; all the plate to be $\frac{1}{4}$in. thick, except the backs, which must be $\frac{3}{8}$in.

GENERAL REMARKS.—Cylinders to be placed 2ft. 4in. apart from centre to centre; and the arrangement of steam and exhausting-pipes, valve-box, &c., to be exactly the same as shown in the Drawing. Distance between centre and centre of frame, 6 feet; from centre of front axle to that of hind axle, 11 feet; hind axle to be $1\frac{1}{2}$ in. clear of fire-box; 5ft. $\frac{1}{4}$in. between centres of hind and crank-wheels. Regulator, as per Sketch. All pipes in smoke-box to be made of sheet brass, No. 9 wire gauge. All steam-joints are to be faced and ground so as to require no sheet-lead.

Feed-pumps.—Valves to be made of brass, precisely according to Drawing. The connexion between the engine and tender to be made with leather hose pipes 2in. diameter, 3ft. long, and attached to copper pipe under foot-plate by means of a tail-pipe screw, &c.; this pipe to be carried along—not through the ash-pan.

The engine to be provided with two safety-valves; one on the top of dome, and the other on the barrel of the boiler; the latter to have a brass pipe to convey the steam above the head of engine-man; each of these valves to be 3in. diameter, provided with Salter's spring-balance; the levers to be proportioned so that 40 or 50 indicated on the balance will be 40lbs. or 50lbs. per square inch on the valve. Glass tube, with a lamp-iron at the side of the glass, having socket $1\frac{1}{4}$in. diameter, 3in. deep; a blow-off cock 2in. diameter under foot-plate; also another 2in. cock at foot-plate, fixed level with the usual surface of water, for the purpose of blowing off any scum which may be on it.

So much of the boiler and fire-box as can must be sheathed with zinc over wood, and kept in its proper position by being encircled with wrought-iron hoops, having tightening screws.

All necessary oil-cups, a complete set of spanners, hand-hammer, and six chisels, to be provided by the contractor.

Two brass name-plates—all joints of levers—bearings of axles or shafts—(except the inner bearings of the crank-axle)—in fact, all moving and wearing parts made of iron, must be case-hardened, and kept in the furnace at least forty-eight hours.

The intent and meaning of this specification is, that the engine is to be constructed throughout of the very best materials and workmanship; and if anything is herein omitted, without which the engine is not complete, the same must be provided by the contractor without any extra charge. If, in the course of the work, the engineer, or any person whom he may appoint, consider that either material or workmanship is in any way defective, the same to be removed by the manufacturer, and others to his satisfaction substituted; and if any alterations from this specification are made, the expense of such shall be added to or deducted from the contract price, as the case may be, the engineer being the only judge upon the subject. The engines must be delivered free on the Grand Junction Railway, and be subjected to such trial, before being paid for, as the engineer may think proper.

ART. III.—TABLE OF THE DIMENSIONS OF MARINE STEAM ENGINES.

(Of Messrs. Seaward and Co.'s Manufacture.)

THE following table of the dimensions of Messrs. Seaward and Co.'s marine engines, will serve to illustrate the practice of those celebrated engine-makers, and will, we have no doubt, be held in considerable estimation by many of our readers. Information of this practical and condensed kind is, indeed, extremely useful; and its value is no doubt enhanced by the general difficulty of obtaining it. Most engineers, we believe, are desirous of keeping the dimensions of their engines secret: and vain as such a hope must necessarily be, it is, we believe, both wide-spread and deeply rooted. The publication of this table ought, we think, to go some way to convince them of its folly, and should at the same time show that the apprehension of injury to individual practitioners, by the exposure of their cherished mysteries, is destitute of the slightest foundation. Will Messrs. Maudslay, or Messrs. Miller, or Messrs. Napier, now discard their own proportions, and adopt those of Messrs. Seaward? Will Messrs. Seaward now get fewer engines to make than formerly, or a less price for them? The supposition is manifestly preposterous. Every engineer thinks his own modes of construction the best; and the varieties in the practice of different makers is chargeable, not upon their ignorance of other modes, but upon a diversity of opinion respecting their relative excellence. Messrs. Maudslay very well know that the framing of the engines of Messrs. Miller and Co. is not of the Gothic order of architecture, but do they reject the Gothic style in consequence? Messrs. Miller no doubt know that their frames differ from those of Messrs. Seaward; and Messrs. Seaward are equally wise respecting the practices of their neighbours; but do we find that this community of information produces a uniformity of practice? So it is in all matters of human concernment; and it is just as preposterous to imagine that the publication of the Vedas should make all men Hindoos, as that the publication of the tenets of a particular engineer should bring the whole of mankind to his opinion.—We must, however, cut this dissertation short. The table has, manifestly, reference only to side-lever engines.

Power.	Diameter of Cylinder.	Diameter of Air-pump.	Stroke.		Diameter of Paddle-wheel.	Diameter of Main Shaft.	Depth of Boss of Cross-head.	Diameter of Piston-rod.	Diameter of Air-pump Rod, copper.	Diameter of Air-pump Rod, iron.	Diameter of Steam-pipe.	Number of lbs. plate for Steam pipe.	Diameter of Waste Water-pipe.	Diameter of Feed-pipe.	Length of Beam.		Bearing of Cross-head (diameter.)	Main-beam Gudgeon.	Radius Rod Bearing.	Weigh-shaft, length of Bearing.	Weigh-shaft, diameter of Bearings.	Diameter of Crank-pin.	Length of Crank-pin.
			ft.	in.											ft.	in.							
10	20	12	2	0	9	4	7	2	1¼	1	4	26	5	1½	6	0	2	3	1⅜	2½	2	2½	2¾
15	24	15	2	6	11	4¾	8½	2½	1½	1¼	5	28	6	1¾	7	0	2¼	4	1½	2½	2¼	3	3¼
20	27	17	2	6	11	5¾	10	3	1¾	1½	5¾	30	7	2	8	0	2½	5	1¾	3	2½	3½	3¾
30	31¾	18½	3	0	13	6¾	10¾	3¼	1⅞	1⅝	6½	35	8	2¼	8	8	2¾	5½	2	3½	2½	4	4¼
40	36½	20	3	0	13	7½	11½	3½	2¼	1⅞	7	38	9	2½	10	0	3	6	2¼	3½	2¾	4½	4¾
50	39½	22	3	6	15	8¼	12¼	3¾	2½	2	7¾	40	9½	2¾	10	6	3¼	6½	2½	3¾	2¾	5	5¼
60	43	24	4	0	17	9	13	4	2¾	2¼	8½	44	10	3	11	6	3½	7	2¾	4	2¾	5½	6
70	46	25½	4	3	17	9½	13¾	4¼	3	2½	9¼	50	10½	3¼	12	6	3¾	7½	3	4¼	3	6	6½
80	48	27	4	6	19	10	14½	4½	3¼	2¾	10	55	11½	3½	13	0	4	8	3¼	4½	4¼	6½	7
90	50	28	4	9	19	10½	15¼	4¾	3½	3	10½	58	12¼	3¾	13	6	4¼	8½	3½	4¾	3¼	7	7½
100	52½		5	0	21	11	16	5	3¾	3⅛	11	62	13	4	16	0	4½	9	3⅝	5	3½	7⅜	7¾
110	55		5	0	21	11½	16¾	5¼	4	3¼	11½	66	13½	4¼	16	0	4¾	9½	3¾	5¼	3¾	7¾	8¼
120	57½		5	6	23	12½	17½	5½	4¼	3½	12	70	14	4½	17	6	5	9¾	3⅞	5½	3¾	8	8½

Art. IV.—ACCIDENTS IN COAL MINES.

Report of the South Shields Committee appointed to investigate the Causes of Accidents in Coal Mines. London: Longman & Co. 1843. Folio, pp. 79.

On the 28th of June, 1839, the coal-pit of St. Hilda, near South Shields, exploded, by which calamity fifty-two lives were lost; and a number of persons practically skilled in mining thereupon formed themselves into a Committee, with the determination to ascertain whether some expedient might not be carried into practice which would avert such disasters for the future. After a labour of three years, this Committee has brought the result of its inquiries before the public in the person of the very important volume before us; and whether viewed in reference to the proficiency of the inquirers, their means of obtaining information, or the patient labour of their research, this report is well entitled to a careful consideration, and indeed deserves a more minute analysis than our limits permit us to give it. It is our duty, however, to offer a few observations which we conceive to be material.

Of the soundness of the views propounded in this document, so far at least as regards their more important features, there cannot, we conceive, be any doubt among practical people. The members of the Committee have manifestly an intimate practical acquaintance with mining operations, and their judgments appear to be discriminating and unbiassed. They have fallen upon that happy mean which lies between impracticable theory and empirical practice, and while courting the illuminations of science, have taken care not to be diverted by its visionary coruscations out of the path of useful progress. However ingenious any device may be, its practical applicability to achieve an important purpose is, in their eyes, the measure of its value; and practical miners will, therefore, have every confidence that the recommendations of this Committee may be acted on, without involving them in great and fruitless expense, or perplexing them with a complication of impracticable refinements. For our own parts, we consider that the expedients this Committee recommends, if carried out into practice, will be productive of an important economy in mining operations, while at the same time, they will go far to render explosions less frequent and disastrous; and, we do think, that the mining interest of this country, and indeed every class of the community, ought to take some means of manifesting a becoming sense of such philanthropic and beneficial labours.

Such are our general impressions respecting the merits of this work, and the obligations under which the public lies to this Committee: but we cannot extend our approbation to the general style of the report or the manner in which it is drawn up. There is a vast deal in it that is redundant; and indeed, viewed merely as a report, and without reference to the weight and utility of its statements, it is unskilful, undignified, and preposterous. Instead of confining itself to a simple statement of the conclusions at which the Committee had arrived, it wanders into arguments respecting the priority of inventions and other matters of the kind with which it had nothing whatever to do, thus bringing down the Committee from the high office of judge to the level of hypothetical disputants. It is not the part of a Committee, such as this, to argue out the merits of rival pretensions, but to state its impression relative to the various facts and reasonings which have been brought before its bar; and the public accepts the conclusions at which it has arrived, not in consequence of any long display of incomprehensible argumentation, but merely by virtue of the general confidence in the soundness of its judgment and the honesty of its decisions. Had the report been a tenth part of its present length, it would have been far less vulnerable and far more useful; and a digest could have been appended containing all the further information the Committee might have wished to render, stamped merely with their general approbation, but without binding them to any of the arguments or speculations it might contain. It is time, however, to give some abstract of the Committee's labours.

The whole inquiry is distributed under the several heads of Safety Lamps, Ventilation, Scientific Instruments, Infant Labour in the Mines, Plans and Sections, Scientific Education of Officers of Mines, Government Inspection, and Medical Treatment after explosion. Under the first head, the following preliminary observations in reference to the explosive gases of mines may be interesting to some readers:—

> "Safety Lamps.—The great element of destruction to miners is the dreadful *Fire-damp*, (light carburetted hydrogen gas,) which is evolved in the greatest profusion from every pore of the coal, as well as from the roof and thill of the mine.
>
> "So abundant is it in some of the northern mines, that to procure a natural gas-light, as this Committee has more than once observed, a small hole a few inches deep has only to be made in the coal, and a tube inserted, when the gas discharges through it so freely as to enable it to be lighted at its end. In the shot-holes made for blasting the coal, it is very common also for the gas to ignite at their mouths.
>
> "At Wallsend colliery, (C. pit,) *for many years* there has been an incessant discharge of gas, which burns at the pit mouth, with a bright light, that is visible for miles. It is conveyed in metal pipes from a single *goaf*, or reservoir, of not more than five acres, into which it pours, 280 yards below the surface, and 2000 from the shaft. Day and night it continues to discharge at the rate of 5 ⅛th hogsheads per minute, and six years ago was more than double that amount.
>
> "At Earsdon pit, (Northumberland,) in the Bensham seam, 104 yards down, when the Committee visited it on the 6th April, 1840, a large staple (a pit within a mine) was being sunk to the low main. About 50 feet below, the surface of the water in this staple was agitated briskly, as if boiling, by the escape of gas; a light with great caution was lowered into it, when the whole surface became a sheet of flame of nearly 30 feet area. It continued to blaze brilliantly, catching the gas as it bubbled from below; now flickeringly, now again in a bright glare, in the most extraordinary manner; it seemed inexhaustible, and was at length extinguished with some difficulty.
>
> "This gas, by the observations of Mr. Witham and Mr. Hutton, appears to be in a highly condensed, if not a liquid state, and probably has been forming and accumulating since the earliest period of the coal depositions.
>
> "Though from its light specific gravity, this gas escapes into the atmosphere whenever exposed, yet the coal still retains a large portion of it: a piece of coal in a pail of water will emit it in abundance; and instances are on record in which ships laden with coal have been nearly destroyed by its disengagement and explosion. On August the 5th, 1816, the ship *Flora*, of London, having just taken a cargo of coals on board in Sunderland harbour, blew up with a terrible explosion; the deck beams were broken, and the decks torn up. On July 4th, 1817, the *Fly*, of Ely, lying at Brandling staith, on the Tyne, with a cargo of coals, just taken in, the gas from it exploded, burnt the captain in the cabin, tore up part of the deck, threw a boat from the hatches, and did other serious damage. Upon the 21st July, 1839, the sloop *Enterprise*, when at sea, with coals from Pembroke to

Newport, Isle of Wight, had an alarming explosion, which fortunately only frightened, but did not injure the crew. And the schooner *Mermaid*, of Guernsey, upon the 29th August, this year (1842,) lying at South Shields, sustained an explosion: she had been laden that day with Hilda coals, and the hatches immediately battened down; when, six hours after, the gas from the coal exploded at the forecastle lamp; one man was knocked down and much burnt in the face, another injured, the mate struck down in the cabin, and a hatch started. A circumstance not undeserving of notice, lightning, in great abundance, was playing in the atmosphere all around the vessel at the time."

The first attempt to lessen the danger of explosion in mines by superseding the use of naked candles in an explosive atmosphere, appears to have been that of Mr. **Spedding**, who, at the beginning of the last century, invented an ingenious instrument, called a "steel mill," which gave out a feeble light by a succession of sparks elicited by a continuous percussion of pieces of flint and steel. This expedient was found to be attended with less danger than an open candle; nevertheless, these sparks from the steel mill sometimes occasioned explosions, and in illuminating power they were exceedingly deficient, while attended at the same time with much trouble to keep them in operation. At the beginning of the present century, **Humbolt** contrived a lamp for dangerous mines, in which the combustion was kept up by a reservoir of pure air. Dr. **Clanny**, some years after, invented something of the same kind; but these schemes were both impracticable, and it was not until 1815, when Sir H. **Davy** turned his attention to the subject, that an anti-explosive lamp was invented which has met with any favour or success. The nature of the safety-lamp of **Davy** is known universally, and the contrivance must be admitted to be of great value; yet its efficacy has been greatly overrated, and a false sense of security has thus been inspired which is full of danger, and to which many explosions are, we think, fairly attributable. Instead of adopting suitable measures for clearing their mines of the explosive gases, many pit-owners have sat down in the cheap and lazy belief that the **Davy** lamp was all-sufficing; and the health of the wretched miners has thus been wantonly sacrificed, and the lives of thousands of human beings kept in continual jeopardy, merely to heighten the guilty profits of a cabal of cruel task-masters. The true alleviation of the evils of the fire-damp are, this Committee plainly shows, to be found in a proper system of ventilation; but then, indeed, this would cost some money, and the security of the lives of the miners is, in the eyes of many mine owners, too trivial an object to be purchased at some little cost. This is the plain English of the doctrines held by a large proportion of our master miners on this subject; and can anything be conceived more scandalous and atrocious? Can any greater enormity be imagined than the wilful sacrifice at intervals of a multitude of lives merely to obviate a necessary outlay? The fact is, the general administration of our mines has long been fraught with the most revolting barbarities, and, in spite of the ameliorations which have been recently introduced, is even yet a burning spot upon the Christian name. But those by whom a salutary change has already been achieved, will, we trust, continue to give their energies to the subject until the storm of the public indignation has been made to burst upon these dealers in iniquity, and sweep their pollutions from the earth with the force and fury of a hurricane.

We have been betrayed into this digression by the vehemence of the indignation naturally called up in our minds by the spectacle of such oppressions. We now proceed to give our readers the summary of the Committee's inquiries relative to Lamps, and we perfectly concur in their conclusions.

"The Committee have now to report, after the most minute investigation and experiment which they have been able to devote to this branch of their subject, that, in their opinion, no mere safety-lamp, however ingenious in its construction, is able to secure fiery mines from explosion; and that a reliance on lamps alone is a fatal error, conducive to those dreadful calamities which they are intended to prevent. The Committee further report, that they are of a decided conviction, according to the foregoing premises, that the naked Davy lamp is, without a complete shield, a most dangerous instrument, and has indubitably been productive of those accidents in mines against which it is still too confidently and generally employed, at the daily imminent risk of producing a like calamity.

"The Committee regret to observe, that from some erroneous conviction, or other less defensible cause, this mode of securing safety in mines has been beyond all reasonable bounds relied on, while the far more important and safe system of *ventilation* has been comparatively neglected."

The usual expedient for keeping a current of air in mines, so as to accomplish their ventilation, is a great furnace so situated in or about the mine as to rarefy a column of air, and thereby put it into motion by its specific levity. Mr. Spedding, about the year 1760, introduced the plan of coursing the air through the several workings—suitable doors and partitions being erected at appropriate intervals to give a right direction to the atmospheric current, so that every part of the mine might be traversed by it, and the inflammable gas be swept away. In some mines the great extent of the workings and the vast length traversed by the circumvolving current was found to seriously impair its velocity; while in other cases the current of inflammable gases passing into the furnace exploded the mine in the same manner as a train of gunpowder. To obviate these evils, Mr. Buddle introduced, thirty years ago, the plan of dividing the quantity of air passing through the mine into several currents, each of which is made to traverse one particular cantonment of the workings, and these currents empty themselves not into the furnace, but into the chimney. In spite, however, of these improvements, when the area of workings is great in proportion to the shaft area, it is impossible to achieve an efficient ventilation, and a dangerous condition of the mine becomes inevitable. Throughout the whole of the north of England the proportion of shaft area is extremely inadequate. The following declarations of this Committee are startling and momentous:—

"The Committee are therefore obliged, from a strong sense of public duty, to record their conviction, derived from personal inspection of many mines, and the fullest official information of many others, *that the system and rate of ventilation of the mines in this extensive Coal District, require a great and important change*; for, if allowed to continue, there is scarce a single mine amongst them, with one or two rare exceptions, that in a day or hour may not be plunged, by some easy contingency, into a destructive explosion: and that *this state of things is produced by too few shafts to the extent of under-ground workings, and the consequent slow rate of air which is produced to sweep the passages, rapidly to remove or fully to dilute the gas.*"

There are three plans by the joint use of which a very efficient system of ventilation might, it appears, be established. These are an increased number of shafts, the excitation of a brisker current by adequate mechanical agency, and the employment of drifts to carry off the supernatant gas. The choice of means for producing a more effectual current seems to lie between the employment of a fan-blast, and the introduction of jets of steam projected up the shaft. This last seems the preferable project, as it does not involve the use of machinery, which might become deranged, and endanger the safety of the mine. The boiler, according to this plan, would be situated at the bottom of the furnace-drift, into which the jets of steam would be sent, and which would, there is no doubt, produce a sufficiently powerful draft to keep up a strong current through all the workings. The explanation of the advantages of gas-drifts we must leave in the hands of the Committee.

"'Mr. Ryan certainly threw some light on the principle of ventilation. He made use of some air-pipes, which he carried from the mouth of the small head up to the upper workings of the thick coal; and by converting the head into an upcast, instead of a downcast head, he by that means took out the inflammable gas that was hanging overhead, and *thus drained the side of work completely. This led to the introduction of making top-heads generally.* By this means all *top-heads* in future were put into the *upcast* shaft *instead of the downcast*; and I believe *ever since that time this system of ventilation has been found quite sufficient for the Staffordshire mines.'* * * 'I always considered there was a great deal of merit due to Mr. Ryan for that suggestion.'"

It appears to us that flexible tubes might be led advantageously along the roof of the mine, so as to draw off the gas from the highest points, and these pipes should all be connected with one main trunk, out of which the gas might be pumped by a cylinder at the surface. We think, also, the coal may often be bored horizontally with advantage, so as to let off the gas gradually in any cases where large internal accumulations are suspected.

"Professor Buckland states in his inaugural lecture, after pointing out the great advantage of *faults*, in elevating conveniently nearer the surface strata that had a continual tendency to bury themselves out of reach, that 'a still more important benefit results from the occurrence of *faults* or *fractures*, without which the contents of no deep coal mine would be accessible. Had the strata of shale and grit-stone, that alternate with the beds of coal, been continuously united without fracture, the quantity of water that would have penetrated from the surrounding country into any considerable excavations that might have been made in the porous grit-beds, would have been insuperable by the most improved machinery; whereas, by the simple arrangement of a system of faults, the water is admitted only in such quantities as are within control.'"

This doctrine respecting the necessity of *faults* to enable mines to be worked has been repeated a thousand and three times; but it appears to us to be perfectly fallacious. But for the faults which dam back the water, a mine sunk in any permeable stratum would, it appears to be supposed, be necessarily overwhelmed. But this doctrine involves the belief that in passing through the said stratum the water encounters no resistance; and if it were true, it would be impossible that water could stand in any well within the limits of the fault at a higher level than it stands at in the mine. The fact is, the intervention of faults, or dykes, does not exercise any inevitable influence on the difficulty of keeping them clear of water; nor can the disruption of a dyke at the distance of a dozen miles, under ordinary circumstances, be supposed to be perceptible in the quantity of water delivered by any mine.

The quantity of gas evolved in a coal mine is materially affected by the weight and temperature of the atmosphere. A thermometer and sympiesometer are, therefore, proper instruments for every mine to have. An anemometer, also, for measuring the force of the ventilating current, is a proper instrument. The employment of young boys in mines, and still more of girls and women, this Committee strongly condemns; and with the view of obviating the inundation of mines from old workings, by which many lives have at different times been lost, it recommends a registry of plans and sections of all mines. It also recommends the establishment of a mining college, so that the officers of mines may have the advantages of a scientific education. It appears Sir C. Lemon has recently projected something of the kind in Cornwall, and has proposed to bequeath it a munificent endowment. The Durham College has lately been exerting itself, and, as we think, judiciously, to develope the advantages of its situation as a school of mining.

We have now given our readers the more important part of the conclusions of this Committee. Their report bears the impress of patient labour and practical skill; it is discriminating, impartial, and judicious; but these high qualities must be marred, we think, in common eyes, by the unfavourable dress in which they are exhibited.

ART. V.—GAS METERS.

Gas Meters: their unfairness demonstrated. Third edition. To which is added, the description of the Patent Dry Gas Meter. By HENRY FLOWER. London: G. Mann, Cornhill. 1843. 8vo. pp. 28.

The title of this pamphlet is sufficient to call up a suspicion that the advice it offers is not altogether disinterested. To cry down an old invention is a necessary preliminary to the crying up of a new one, and if Mr. Flower is anxious to bring under the notice of the public the merits of the "patent" gas meter, it is only natural that he should begin by the assurance, that the meters at present in use are exceedingly defective. Of the existence of these great defects, however, we must confess ourselves exceedingly sceptical; and, although it is not to be denied, that a dry meter would be preferable to a water meter, if any one could be devised, which was free from countervailing disadvantages; yet, we are very confident that no dry meter has yet been invented of equal excellence to the water meter in common use, nor are our hopes high, that any such dry meter will be speedily discovered.

The ordinary water meter consists of a species of drum, divided into three or more compartments by internal diaphragms, and which revolves in a close vessel, somewhat more than half filled with water. There are openings into these compartments, so as to permit the water to rise in them as high as it is in the containing vessel, and into the upper portion of the compartments, the gas is admitted through the axis of the drum. This gas pressing on the surface of the water on the one side, and against the diaphragm on the other, forces the drum into revolution, and at the same time depresses the level of the water in the chamber to an extent proportionate to the friction of the machine; but as the friction is very minute, and, besides, is nearly uniform, no inaccuracy in the indications of the slightest moment can arise from this cause. Each chamber as it emerges from the water becomes of course filled with gas, and the gas is of course expressed from each chamber, as it again becomes immerged in the water. The number of revolutions of the drum is therefore indicative of the number of chambers full of gas, which have passed through the instrument, and this quantity is expressed in cubic feet upon certain dial plates with appropriate hands, which are turned by trains of wheel work.

The advantages of this description of meter are, its cheapness, simplicity, and correctness. There are no valves, pistons, or other mechanical appliances, which with continued working are sure to become leaky, even if they can be made tight in the first instance, and the machine is for the most part composed of common tin plate, so that its cost is very moderate. It is, however, subject to two objections; if placed in a hot situation the water in the external vessel will evaporate rapidly, and if placed in a perfectly exposed situation, the water may freeze in winter. The remedies for these evils, however, are simple and obvious, and consist merely in taking care that the instrument shall not be placed in those situations. A layer of sawdust around the meter will, we understand, prevent the freezing of the water under almost any circumstances which can arise in practice; and the evaporation of the water, though an evil, is one which tells only on the gas companies. We admit with Mr. Flower, that "a false balance is an abomination," but the sin, we submit, becomes venial, when the fraud which the seller winks at is one which tells only *against himself.*

Mr. Flower tells us, that the people whom the gas companies employ, sometimes purposely vitiate the indications of the instrument, by putting too much water into the meters. This may be so, but we suspect the occurrence is an unfrequent one, and it admits of easy detection. Every meter is provided with an overflow hole, out of which the water will run upon the removal of a plug when the meter is too full; and every householder has it in his power to see that no fraud is practised against him, by merely taking care that this plug is left out when the meter is replenished with water. Mr. Flower says, that ammoniacal liquor is apt to accumulate in the meters, and render them fallacious. We doubt the fact; but if such an evil is found to arise in any particular situation, it is obviously a very easy matter to take out the plug, and let off the excess of liquid which will cure it at once. It is manifest, moreover, that the existence of ammoniacal vapour in gas is no fault of any particular kind of gas meter; and if this vapour condenses in the pipes, and runs down upon the meter, the evil is one which must continue to arise whatever description of meter is employed.

Mr. Flower is at some pains to assure us that he has himself no interest in the particular meter he recommends, and that he at first had some difficulty in getting any of the particulars of its construction from the patentee. This may be so—Mr. Flower may have written his pamphlet out of the purest motives, and not to bring himself into note as a gas doctor as some have asserted. Of the probability of this supposition, our readers may, perhaps, form the best judgment from the following extract from the preface of the *first* edition of his pamphlet:—

"I shall be happy to put myself in communication, if it be desired, with large consumers of gas, who may think that a just measure of quantity from their meters is a *desideratum.*"

The dry meter Mr. Flower recommends is, we think, open to many objections; and would speedily get into disrepair; whereas many of the common meters have been in continued operation for twenty years, and upwards. Mr. Crosley, the original patentee, has brought them to great perfection; he has introduced new kinds of metals into the construction of the meters, which obviates the corrosive action of the gas, and the secret of compounding which he possesses exclusively. Most of the new projects in gas meters brought forward of late years, are mere revivals of schemes he had tried and rejected many years ago; and we do not conceive that any better meter than his now is, is likely to be invented, nor are its defects of a sufficiently important nature to make a new description of instrument any great desideratum. With these remarks, we take leave of Mr. Flower—his pamphlet is a trivial, talentless, and inflammatory production; and will only be held in estimation by such cognoscenti as the lady-bird sages of the Adelaide Gallery.

ART. VI.—OUR CLUB. No. II.

ACT I.

No! Science cannot leave her hill,
And shine with heavenly radiance still:
Strive not to draw her from the skies,
But to her bright meridian rise.
Those who would nobler prospects view,
And drink the living ether blue,
Must boldly scale the mountain rude—
The spell is in the altitude.

SCENE—*The Architectural Library.*

Dramatis Personæ—SIR JONAH, MONTGOMERY, *and* MR. WEALE.

MR. WEALE. The work is much admired, and has created a great sensation; yet there are a few sedate people who are scandalized at the Bacchanalian orgies brought to light in the dialogues; and who question, moreover, whether so much wit does not derogate from the dignity of science.

MONTGOMERY. The dullards! as if wit and science were necessary antagonists.

MR. WEALE. They say, too, that the said dialogues have very little reference to mechanical works.

MONTGOMERY. And what of that? Is it criminal in those skilled in mechanical works to breathe a word about anything except steam-engines and spinning-jennies? Are mechanicians to be condemned for remembering that they are also *men?*

MR. WEALE. These are the frivolous objections of frivolous minds: wit and science may certainly co-exist in the same class, or in the same individual; and the doctrine that they should not be united in the same discourse, or collection of discourses, has no foundation in nature.

SIR JONAH. You are right; and those alone will think otherwise who judge *empirically*, instead of referring to those first principles on which every sound judgment must ultimately rest.

MR. WEALE. The people who judge by rule have some reason to abuse you, for you have put them sadly out: there never was a case of more perfect bewilderment; all their old landmarks were swept off as by a whirlwind, and they really did not know what to think or say. The first glimpse of the Preface was, I believe, as good to many persons as a shock from a twelve-jar battery.

MONTGOMERY. To be shocked is the necessary condition of being electrified.

MR. WEALE. Yes, the electric effects will now come: the first emotion of surprise once over, the merits of the dialogues will receive some attention; and dull and insensate must that man be, on whom they fail to exercise an animating and exalting influence.

SIR JONAH. At what value are their merits estimated?

MR. WEALE. At the very highest. Some persons, as I have mentioned, questioned the propriety of their introduction into a scientific work; but all who have looked into them allow that they are in themselves admirable. I have not heard a single opinion to the contrary.

SIR JONAH. Many persons do not see the purpose of the dialogues; that purpose we do not mean to announce; and it can only be unfolded by degrees. I may say, however, that it is a weighty one, and has not been inadequately considered. Twelve months hence, our superfine literati may understand more about our aims, as well as about our means of giving them effect.

MR. WEALE. No doubt: they will by then understand with whom they have to deal, which I in part understand already, and which enables me to form some estimate of your future achievements. You will regenerate, I can foresee, all the arts, whether useful or ornamental—add vigour to refinement, and refinement to originality. You will touch the hearts of the illiterate with a live coal from the altar of genius, so as to make them know their own strength, and exercise their latent gifts; and will bring out from the mine and the workshop those despised children of a finer mould, who constitute the aristocracy of nature.

SIR JONAH. We trust to exert an influence which will be beneficial to all classes, and contribute to maintain the equilibrium of society. The god of our idolatry is not an avenging, but an averting power—not "the destroyer" of a cruel mythology, who descends at long intervals to avenge a series of consummated crimes, but the purer spirit of a better faith, which is ever present, with its worshippers, to guide, admonish, and restrain.

MR. WEALE. I believe it; and you have taken the wisest means of accomplishing these benignant purposes. The wit and humour which some charge upon you as superfluous, are in reality among your most necessary instruments. You have a higher and holier end than the mere communication of technical knowledge; and a little well-directed ridicule will often do more to cure an epidemic vice, than a thousand dull and well-meant preachments. Indeed, in any set admonitory discourse, it is rarely you can tell a man anything he did not know before, and you leave off just where you began; but, only make a practice ridiculous, and you give every one a powerful motive for its relinquishment. "Punch," I believe, has done more to correct the vices and follies of the age, than all the sermons published within the last twenty years.

MONTGOMERY. For my part, I suspect those who find fault with our occasional folly, are themselves chargeable with folly which is *not* occasional. In our case, however, it might be argued, the folly is a crime; whereas, in theirs, it is only an affliction.

MR. WEALE. Yes, I agree with Dr. Johnson, in thinking that the man who is not content to be sometimes a fool, is always one.

(*Enter* MR. JOBBINS.)

MR. JOBBINS. Gentlemen, I have to complain of a great injustice you have inflicted upon me. In reviewing the "Architectural Drawing-Book," you have made it appear that the plates were line engravings, whereas they are lithographs, executed by your humble servant.

MONTGOMERY. Tell that to the marines.

MR. JOBBINS. It is a *true* fact. I appeal to Mr. Weale.

MR. WEALE. It is: and I have also something to complain of; namely, your attack upon the Putney College. The College is now well conducted, and is one of my best customers.

SIR JONAH. *Attack?* Defence, you must mean. The Engineers say it is an attack upon them. I only trust that the College may make a good use of our suggestions.

(*Enter an* EXQUISITE, *with two moustachios, one imperial, and a considerable air.*)

YOUNG GENTLEMAN. Are you the owner of this shop?

MR. WEALE. I am.

YOUNG GENTLEMAN. Au—What new works in science—au—have you—au?

MONTGOMERY (*aside*). Just imported.

SIR JONAH (*aside*). Or escaped from Wombwell.

MR. WEALE. Not many just now, Sir; times are too bad. Here is a new work on railways, and here another on bridges; both very good and very cheap.

YOUNG GENTLEMAN. Too heavy reading.

MR. WEALE. And here is a new periodical called "The Artizan," which is making a great stir just now—price one shilling.

YOUNG GENTLEMAN. Faugh!—Artizan—something low. Au, yes—Preface—cannot even write English. I have not yet learned the language of the "great unwashed."

MONTGOMERY. Nor the sense. I pity you sincerely, for I fear your case is hopeless; but if you go home, read "The Artizan" carefully, and shave off your moustachios, you *may* perhaps recover; it is, at least, your only chance.

SIR JONAH. There is no surer mark of vulgarity than to be perpetually showing a horror of it.

MR. JOBBINS. The poor have often vulgar manners, but the rich have too frequently vulgar hearts.

(*The young gentleman is dissipated.*)

MR. JOBBINS. I forgot the letters. Here are six, and there have been eight persons at the office this morning, dying to know who wrote "Our Club." It is next, every one says, to the "Noctes Ambrosianæ," if not quite equal to those renowned productions.

SIR JONAH. What say the letters?

MONTGOMERY (*reads*). "It was only a few days back that I was aware of the existence of so original and talented a work as 'The Artizan.' You have opened quite a new field in literature, by a journal on this plan. Mechanics and science have their poetry, as well as the fine arts. Do not let such a sumph as the editor of the"—

SIR JONAH. No names.

MONTGOMERY (*continues.*) "Move you one jot from your path. The 'Noctes' have been so long discontinued, that *all* the rising engineers never heard of them; and you no more are imitators of them than they were of Plato's symposium. Be original and bold, or you will gradually drop to the level of the lumber of"—

SIR JONAH. Hush! it is full of treason.

MONTGOMERY (*continues*). "There is no work on science that I know with a line of genius in it. We want *genius*, not mere talent and mathematical formulæ; but principles, and philosophy, and poesy, and originality, and literature, all bearing upon the object and design of the work. Every artizan has a wife, or mistress, or sister, or some sort of feminality; and how often have I heard these loathe the dulness of the scientific works taken in by their lords? There must be a great deal of interesting matter belonging to the useful arts, which has never had a proper field for its display, and which can find no outlet except through your excellently designed work."

SIR JONAH. That letter is the emanation of a very superior mind.

MONTGOMERY. This one is too long to read; I will give you its concluding paragraph (*reads*): "I have no doubt of the success of your magazine, if you continue with equal talent. Good writing always calls up good writers, and I want to send you a song that shall make crowds consider it an honour to be a contributor," &c. &c. I wonder what that song will sing of. This next letter is too long to get through now; but here goes a piece of it at random (*reads*): "Your article on the College for Civil Engineers is admirable. What you say about science and engineering is exceedingly just; I have scarcely ever read a better article any where. It is both most forcible and most judicious; and in propriety of style and language scarcely capable of being rivalled—at least, only by such men as it is an honour to be said to be rivalled by. It is not too antithetical; altogether it is a masterly article, well worthy of the blue and buff, even in its halcyon days. I like, too, its quietness, no appearance of effort, or pretence, or labour. 'Our Club' is most felicitous, some of it truly beautiful, and as just as beautiful. Gray's two paragraphs about the covenanters is what I like well. The simile, 'She disappeared in the foamy surge, as the sun-licht dies upon the ocean,' &c., is exquisite; and all about the regicides is most striking and just."

SIR JONAH. That's enough: it is happy for us that our heads are not easily turned.

MONTGOMERY. I had better give you a piece of this one; I have broken the seal (*reads*): "I have delayed too long in congratulating you on the universal good opinion (which no doubt has reached you from other quarters) that I hear every where expressed of 'The Artizan.'"

SIR JONAH. Yes, yes, we have heard it. That will do, you will tire Mr. Weale to death.

MR. WEALE. Far from it; these letters are most interesting, and they evidently come from competent judges.

MONTGOMERY (*continues*). "I have seen the notice of 'The Artizan,' in the *Spectator* newspaper, hinting that the article 'Our Club' would not succeed. But my friends here, with myself, think very differently; especially if the great talent shown in it can be sustained in future numbers to any moderate extent; and this opinion is not confined to my North Country friends, who I need not say are delighted with it."

SIR JONAH. The *Spectator!* has it noticed the work?

MONTGOMERY. So it would appear.

SIR JONAH. The *Spectator* is an able paper, and an honest one; yet, I am ashamed to say, I scarcely ever see it.

MONTGOMERY. It is very much out, if it has expressed doubts of the success of "our club."

SIR JONAH. Yes, if a large sale be the measure. The *merits* of the work is a different affair, and one upon which we shall be glad to have the candid opinions of competent persons. Whatever the execution may be, the plan is at least a good one, and our extraordinary success certainly justifies us in adhering to it.

(*The gas meter gets dry, and its screw gets drunk.—The lights wax dim.—A total eclipse.*)

ACT II.

Knowst thou the club room where science and whiskey,
Wine, wisdom, and witchery always abound?
Where frolic rolls wildly as breakers in Biscay,
And harmony triumphs in soul and in sound!
Knowst thou the club room where friendship and worth
Conspire to create a new Eden on earth;
Where genius comes forth in a halo of light,
Illumining tracts long surrendered to night,
And the wildfire of wit all delightfully driven,
Flashes fast as the magical meteors of heaven?
'Tis the Artizan's club room, the temple of fun,
Can you frown on the courses its children have run?
Oh! bright as the hues of an archangel's wing
Are the tales which they tell, and the songs which they sing!

SCENE—*The Club Room.*

Present, SIR JONAH, GRAY, MONTGOMERY, *and* SCALPEL.

GRAY. Its mirawculous, fifteen hunner in fifteen minants; we'll shune need a railway to hurl them down to "The Row."

SIR JONAH. Are you aware that there are some persons who do not like "Our Club."

GRAY. Ou aye, there's fules to be faund in every land, an' what for no in this? I've weichted their letters, an' there's just twa unce exactly.

SCALPEL. Two ounces of disapprobation—and how many of praise?

GRAY. Sax pund an' a half; there's the letters, an' I've made an allooance for the waux.

SIR JONAH. It seems some of the newspapers don't like the dialogues at all.

GRAY. The puir infawtnated indiveeduals!

SIR JONAH. They think they have hardly enough decorum for a scientific work.

GRAY. And wha says oors is a scientific work? It's naethin' o' the kin.' It's a work of wut, an' genius, an' skill, an' common sense. Ony body can mak' a scientific work, but wha can mak' a work like oors but oorsells?

Sir Jonah. They think lightly of "Our Club."

Gray. May-be they'll chaynge their opinions when they hae had the wecht o't on their shouthers. But what's the use o' mindin' the haivers o' ony body? we ken brawlies what *we* can dae, and we ken the diameter o' cylinder o' the scienteefic Solons, an' may-be o' some o' the leeterary anes as weel, an'— But the fac' is, the folk are chawed that we divna weer horse-hair wigs an' coort dresses, an' carry a pair o' taws in our han's, or a cane aneath oor oxters like a wheen o' schulemaisters, an' sit in a chawmer whaur there's nae bottle ava forbye a Perryan fountain. This is the wye they carry on; but we'll no do it; oor weapon is a *Club*, an' the Glenlivet is the fountain o' oor inspirations.

Scalpel. What sort of expansion-valve do you recommend for a marine engine?

Gray. A slide.

Scalpel. And piston?

Gray. Metallic wi' a single ring an' tongue-piece; Maudslay's are gay gude.

Montgomery. Miller's are of a similar description. If of any considerable size they should always have springs at the back. The spring of the ring itself is not sufficient.

Sir Jonah. We are preparing a paper on the different kinds of pistons, illustrated by drawings, which will, I believe, be ready soon.

Gray. Weary me if you twa neerdoweels hae nae divulged every drap o' the punteh arredis!

Montgomery. An insufferable calumny! Retract.

Gray. Retrack? man, there's Scalpel as fu' as the Euphrawtes, an' yoursel'—i' faith it was extrordinar, for the piston-rod's wisdom stood rebuked, an' every man gaed ben, but the Maggazin rose to a greater eminence than ever, an' the licht o' its pouther filled the sky.

(Gray *falls into a gentle slumber.*)

Scalpel. Considerably cut.

Sir Jonah. Yes, you see how it is, and there is no use in holding any argument, for he's past convincing. I wish you would sing us something: a song would rouse him up.

Montgomery. Try if you can knock off something about his majesty the "Artizan."

Scalpel. Well, I can only try. (*Sings.*)

1

O the Artizan of England,
What king so loved as he,
A chosen band
He may command
In all his kingdoms three;
For wit and worth
Through all the earth
Beyond compare is he;
O, may he sway
The sceptre aye
Of England's magazinety.

2

O, the Artizan of England,
When club carousals come,
With hearts of fire
His bards aspire
To wake the kettle-drum.
To drive away
Sour algebra,
And dull philosophy:
O, the Artizan
Of England,
What monarch great as he?

Gray. It's a' Inglan', Inglan', Inglan', wi' ye—I'll no' sit by an' see Scotlan' negleckit.—(*Sings.*)

3

O Artizan, O Artizan,
I sing thy brightest gem,
The thistle braw,
O' Scotia,
Hit crowns thy diadem.
Montgomery. And Erin's vine
Triune shall twine,
Around the rose's stem;
O Artizan,
O Artizan,
What garland like to them?

4

Omnes. To the Artizan of every land,
Our glasses let us raise;
And hand in hand,
With reverence stand,
To drink our monarch's praise.
Hurrah! your han',
The Artizan,
A bumper! three times three;
Long may he reign,
O'er earth and main,
In peerless majesty.

(*Considerable scuffling of feet, and rattling of glasses, with which accompaniment the curtain descends.*)

Art. VII.—TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

Transactions of the Institution of Civil Engineers. 3 Vols. 4to. London.
John Weale, and Longman and Co. 1842.

The Institution of Civil Engineers was founded in 1817, by a few gentlemen, who were then young members of the engineering profession; but attracted little attention till 1820, when the late Sir Thomas Telford, at the request of the members, assumed the presidency of the new society. He continued till his death, in 1834, to discharge with great zeal and assiduity the duties attached to the situation, and had the satisfaction of seeing the Institution progressively increase in importance and in numbers. It is to the unwearied exertions of Telford that it principally owes that rank and consideration which it has attained among our other institutions for the promotion of science and art. At his death, Mr. Walker, the present eminent engineer, was chosen as his successor, and has since continued to occupy the chair of President of the Institution, which now consists of 475 members in all, including most of those whose reputations are highest as engineers, together with several honorary members illustrious for their scientific attainments.

The meetings of the Institution are weekly during its session, which extends over about five months of the year. The proceedings at the weekly meetings consist chiefly of the reading of a paper on some engineering subject by one of the members, and a discussion on the opinions or facts advanced by him. Previous to 1836, none of the papers thus read before the Institution had been published; but in that year the first of the volumes now before us appeared; the second was issued in 1838, and the third last year. These volumes, therefore, comprise the whole published Transactions of the Institution, and afford a fair criterion of the success of its labours. They contain 68 separate papers, by nearly as many authors, on a great variety of subjects, ranging over every department of Engineering: and if some of these papers are of a trifling cast; if two or three are even a little tinged with the ludicrous or absurd; there is a larger proportion valuable as records of important facts, and as media for diffusing that practical knowledge which the engineer in extensive practice cannot fail to collect from his every-day experience. We shall reserve, however, any more detailed expression of our opinion on these volumes as a whole till we have examined some of the individual papers of which they are composed; and in doing so, it will be most convenient to class them according to the subjects of which they treat. We shall commence with a subject that has occupied a considerable share of the attention of the Institution, and which at the same time possesses considerable interest for the public generally. We allude to the question of the comparative economy of the Cornish, and Bolton and Watt engines. For many years the engineers and proprietors of mines in Cornwall have reported the economic performance of their engines as being far superior to that of any other; and, as a proof of their superiority in this respect, have adduced the quantity of coals burned, the quantity of water raised, and the depth from which it was lifted by the fuel consumed. They were never very successful, however, in convincing others of the truth of their representations, which some rejected as erroneous, because the water said to be raised was *calculated* from the size of the pumps and the number of strokes made, on the supposition that a quantity of water equal to the solid contents of the pumps was delivered at each stroke, whereas it was contended, by those who opposed the claims of superior merit advanced on behalf of the Cornish engines, that the pumps were, in reality, in great part filled with air, and consequently did not deliver nearly so much water as was supposed. Others, again, opposed the Cornish pretensions, because they were "contrary to the laws of nature;" and many were content to believe there could be nothing in them, because it was very improbable that the engineers in Cornwall were superior to all others. In all questions of this sort, carefully conducted and well authenticated experiments are the only sure means of settling the controversy; and these have now been furnished. They have decided in favour of the Cornish engines: they have shown that the accounts given by the Cornish engineers, of their performance, were correct; and they have led to the erection of a Cornish engine at the East London Water-works. An account of the performance of this engine has been published by Mr. Wicksteed,* the company's engineer, and fully bears out the high character for economy that was given to the engines of that class by their supporters.

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* "An Experimental Inquiry concerning the relative Power and useful Effect produced by the Cornish and Bolton and Watt Pumping-Engines, and Cylindrical and Wagon-head Boilers. By Thomas Wicksteed, Engineer to the East London Water-works, &c., &c. London. John Weale. 1841."

In November, 1835, Mr. Wicksteed read his first paper on this subject to the Institution of Civil Engineers,* in which he describes a tour of inspection which he undertook for the purpose of examining some of the Cornish engines in that year. He describes their principal peculiarities, and gives various details respecting them, which he had collected from his own observation and the reports of others whom he conversed with on the subject in Cornwall; but as he had at that time made no experiments himself to determine the quantity of work these engines performed by the consumption of a given quantity of coals, their performance still rested on the authority of the Cornish engineers alone.

In 1837, however, he again presented a paper to the Institution, (Vol. II.,) giving an account of a second visit to Cornwall for the purpose of making inquiries and trying some experiments on the Cornish engines, for the information of the East London Water Company, who contemplated purchasing an engine of this sort.

The engine upon which, on this occasion, he experimented was the one at the Holmbush mines, with a cylinder of 50 inches diameter. He *weighed*† to the fireman 94lbs., or a Cornish bushel of coals, and counted how many strokes the engine made while these were being burned. He had previously had the water discharged by four or five different strokes conveyed into a box made for the purpose, where it was measured and weighed. From this he determined that the weight of water raised per stroke was $285\frac{6}{10}$; the height it was raised was $535\frac{1}{2}$ feet; and the number of strokes made by the steam from the one bushel of coals was 672. Whence it follows, that the weight of water raised one foot high by one bushel of coals was $(285{\cdot}6 \times 535\frac{1}{2} \times 672) = 102{,}721{,}323$. This, in Cornwall, is called the "duty" of the engine. It is the effective work an engine will perform with a bushel of coals, besides overcoming the friction of the engine and pumps. The trial lasted $2\frac{1}{4}$ hours, and every precaution was taken to prevent the engine-man, if he had been so inclined, from using any unfair means of increasing the apparent "duty." Mr. Wicksteed has also calculated what the delivery of water ought to have been if there had been no leakage in the pumps, and found it to be 117,906,992 lbs., raised one foot high for the bushel of coals. The leakage in the pumps, therefore, amounted to (102,721,323—117,906,922)= 15,185,669 lbs., or about 15 per cent. of the whole quantity raised.

The "duty" of engines in Cornwall is always *calculated* from the size of the pumps, the height of the lifts, and the length of the stroke, on the supposition of there being no leakage; so that for comparison with other engines, the duty of the Holmbush engine must be taken at 117,906,992. This is also the best way to calculate the duty, if the merits of the engine are sought to be determined; for it is evident that, however much leakage there may be, it removes none of the strain from the engine; *it* is always loaded with the full weight of the column of water.

The *measurement* of the water, however, by Mr. Wicksteed was a very efficacious way of convincing every one of the error of alleging that the pumps were to any great extent filled with air. In this experiment we can see only one omission. It is stated that the water was raised by three separate lifts of pumps; but we are nowhere told whether or not the upper lifts did not get some water collected from the sides of the mine which had not been raised from the bottom by the lower lift at all. If such was the case, it is evident that the duty is estimated too high, inasmuch as the whole water delivered is supposed to have been raised from the bottom.

About the same time, another paper was read on the same subject to the Institution by Mr. Henwood, the Assay Master of Tin in Cornwall. He experimented on three engines and found the duty performed by a bushel of coals to be as under:—

Engine at Huel Towan	86,585,079
,, Binner Downs . . .	73,877,810
,, East Crinnis . . .	73,954,606

The bushel of coals, in these trials, varied from 100lbs. to 83lbs. in weight.

The duty in these three engines falls very considerably short of that of the Holmbush engine, as determined by Mr. Wicksteed, but the duty of a bushel of coals consumed by Bolton and Watts' pumping engine at the East London Water Works is only about 40,000,000, and the duty of his Albion Mills rotatory engine, as determined by himself, was only about 20,000,000 per bushel of coals. There is, therefore, even at the lowest estimate, a great superiority in economy in favour of the Cornish engines.

As we have already intimated, the East London Water Company have now a Cornish engine at their works at Old Ford. It was started in December, 1838, and has since been constantly at work. From Mr. Wicksteed's published account of its performance, we learn that it raises 105,664,118lbs. of water 1 foot high with 112lbs. of Welsh coal. This for the Welsh bushel, or 94lbs. of coal, would give a duty of 88,682,385. This is the duty, as estimated from the *measurement* of the water actually raised. It is stated that the leakage in the pumps is ascertained to amount to 2 per cent., so that this duty should be increased by 2 per cent. to make it comparable with the reported duty of other engines in Cornwall.

The superior amount of duty derived from a given quantity of coals, in the Cornish engines, being thus clearly established, it becomes a question of some interest to determine what peculiarities of structure produce this wonderfully increased efficiency. To enable us to do this, it will be necessary to enumerate the principal points in which the Cornish differ from the Bolton and Watt engines.

In pursuing this inquiry, it will contribute much to the elucidation of the subject if we keep the comparison of the boilers and engines distinct from each other. We will ultimately find that a part, although a small one, of the superior duty of the Cornish engines is due to the boiler. The boiler and engine, therefore, both contribute toward the final result; but, nevertheless, the questions as to the economical performance of the Cornish *boilers* and of the Cornish *engines*, are perfectly distinct, and it is quite conceivable that the Cornish boiler might have been worse than the waggon boiler, and yet the duty of the boiler and engine together might have been much greater than that of the Bolton and Watt boiler and engine. We shall, therefore, keep these two parts of the apparatus distinct, and examine, 1st, the relative merits of the Cornish and waggon boiler; and, 2nd, the comparative economy of the Cornish, and Bolton and Watt engines. If we succeed in getting a correct idea of the causes which regulate the performance of each, we shall then have no difficulty in determining all the circumstances that affect their duty in the aggregate. The additional clearness and precision that is introduced into all investigations of this kind, by keeping constantly in view the separate and independent action of the boiler and engine, has been very forcibly pointed out, and well exemplified, by Mr. Josiah Parkes, in two papers he has contributed, on Boilers and Engines, to the Transactions now before us. In the first paper he has given us the details of some experiments performed by himself, at Warwick, on common waggon boilers. These experiments were intended *primarily* to prove the efficacy of a plan which he invented for consuming smoke, but into that inquiry we cannot at present enter. We notice his experiments because they led him to increase the boiler surface, by the addition of a new boiler, and diminish by nearly one half the rapidity of the combustion in the furnace; by which he produced an increase of one-fifth in the evaporative power of a given weight of fuel. These facts are noticed here because they are necessary to the understanding of some of the remarks that are to follow. Mr. Parkes' second paper more directly bears on the present inquiry. It contains no new experiments on Cornish engines, but in it he has tabulated the results obtained by several previous experimenters, particularly Mr. Wicksteed and Mr. Henwood. He has tabulated along with these the results of his own experiments at Warwick, which we have just mentioned, and also those of Watt's experiments, at the Albion Mills engine, as given by Mr. Farey, in his Treatise on the Steam Engine. He has likewise added the particulars of Smeaton's experiments on his atmospheric engine, at Long Benton, as given by the same author. In separate columns he has also tabulated all the important particulars of these different boilers, such as the quantity of heated surface, size of fire grates, &c., &c. By these means he has given a connected view of the different steps that have been made from Smeaton's circular haystack boilers to the present Cornish boiler, and he has annexed similar data for locomotive boilers, taken from Pambour's Treatise on Locomotives, by which means he is enabled to show in a very striking way the contrast that exists in almost every respect between the locomotive and all other boilers.

We have, in Table 1, collected a few of the principal results exhibited in Mr. Parkes' very voluminous tables, and we have added the two columns on the right hand side of the table to show at the same time the evaporative economy of the boilers in use at the East London Water Works. One of these boilers is on the Cornish plan, and attached to the Cornish engine there, which we have already had occasion to mention. The other is a waggon boiler, with an internal flue, for supplying steam to a Bolton and Watt pumping engine. The Cornish boilers are cylindrical, with an internal flue, and as they are generally used with steam of from 15lbs. to 35lbs. above the atmosphere, they are made of plates half an inch thick. The left hand column in the table gives the mean results of experiments made on the boilers at the Huel Towan and United Mines, in Cornwall. The second column from the left is devoted to Mr. Parkes' experiments at Warwick; and, according to him, about one sixth of the evaporation there given is due to his smoke consuming apparatus. The third column exhibits the mean of eight experiments on waggon boilers, at the different places indicated at the head of the column, which were all (except the Albion Mills experiments) conducted by Mr. Parkes. The fourth column from the left contains the results of Mr. Smeaton's experiments on his atmospheric engine, at Long Benton; and the fifth column gives the mean of eleven experiments on locomotives, by Mr. Pambour.

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* The papers in the "Transactions" bearing on this subject are:—

Vol. I. On the Effective Power of High-pressure Expansive Condensing Steam Engines in use in the Cornish Mines, by Mr. T. Wicksteed, Civil Engineer.

Vol. II. A second paper on the same subject, by the same Author. On the Application of Steam as a Motive Power, considered especially with reference to the Economy of Atmospheric and High-pressure Steam, by George Holworthy Palmer, M. In. C. E. On the Expansive Action of Steam in some of the Pumping Engines in the Cornish Mines, by William Jory Henwood, F.G.S., Assay Master of Tin in the Duchy of Cornwall. On the Evaporation of Water from Steam Boilers, by Josiah Parkes, M. In. C. E.

Vol. III. On Steam Boilers and Steam Engines, by Josiah Parkes, M. In. C. E. Remarks on the Duty of Steam Engines employed in the Mines of Cornwall at different Periods, by John S. Enys, Esq., Ass. In. C. E.

† The custom in Cornwall is to *measure* the bushel of coals, and the weight of the bushel varies according to the quality of the coals from 100 to 80 lbs. The *average* weight, as given by the Messrs. Lean in their monthly reports of the duty of the Cornish engines, is 94lbs. In the present paper the *actual weight* will generally be given, but where it is not, the *average* weight of 94 lbs. must be taken as the nearest approximation.

TABLE I.	Mean of Huel Towan, and United Mines boilers, in Cornwall.	Mr. Parke's boiler, at Warwick.	Mean of 8 experiments at the Albion Mills, Clithero, Preston, and New River Water Company, of London.	Smeaton's Atmospheric Engine, at Long Benton, Northumberland, 1772.	Mean of 11 of M. Pambour's experiments on the Locomotives of the Liverpool and Manchester Railway.	Cornish boiler at the East London Water Works, 1839.	Boulton and Watt boiler at the East London Water Works, 1839.
NATURE OF THE BOILERS USED.	Cylindrical with internal flue.	Waggon.	Waggon.	Circular or Haystack.	Locomotive.	Cylindrical with internal flue.	Waggon with internal flue.
Total area of heated surface in square feet	962	152	342·8	459	334·6	798	588
Length of circuit made by the heat in feet	155	50·66	72·5	52·8	7·0	83·1	78
Area of fire grates in square feet	23·66	23·33	26·09	35·10	7·03	14·25	37·26
Weight of fuel burned on each square foot of grate, per hour, in lbs.	3·46	4·00	10·75	20·34	79·33	46·82	13·31
Cubic feet of water evaporated by 112 lbs. of fuel	21·19	18·50	15·88	15·00	12·92	15·27	13·97
Cubic feet of water evaporated per hour	15·45	15·52	39·01	4·84	64·48	44·9	61·9
Square feet of heated surface for each cubic foot of water evaporated per hour	69·30	10·99	10·77	5·10	6·02	71·09	9·5
Square feet of heated surface for each square foot of grate	39·99	6·45	13·88	13·08	47·59	40·40	15·78
Pressure of steam above the atmosphere in lbs.	42·2	2·5	3·68	1·5	50	15·45	
Kind of coal used.*	W.	S.	L. & N.	N.	Coke.	N.	N.

* W. Welsh.—S. Staffordshire.—L. Lancashire.—N. Newcastle.

(See Table III. at the end of this article.)

Referring to the sixth line, it will be seen that the mean evaporative economy of the Cornish boilers is about the same as that of the Warwick boilers; but if we exclude the East London Water Works boiler, the other Cornish boilers will show a decided superiority over all the rest. Lines five and eight show two of the principal peculiarities in the proportions of the Cornish boilers. It will be observed, that the extent of their surface exposed to the heat, for each cubic foot of water evaporated, is about seven times as great as in any of the others. The combustion in their furnaces also is carried on at a very slow rate, there being only about 3¼lbs. of coals burned on each square foot of grate. The only boiler that makes any approach to them in slowness of combustion is the one at Warwick. Mr. Parkes is a great advocate for slow combustion, and he founds his opinions principally on its effect in the Warwick boilers, at least it is from his experiments on them that he derives his opinion that the principle should be carried so far as it was in that case. We conceive that in this instance he has overlooked one very material circumstance. It will be observed in the table, that the heated surface bears very nearly the same proportion to the water evaporated in these boilers as in the other waggon boilers; but before Mr. Parkes altered his furnaces, much more water was evaporated per boiler, and, consequently, the heated surface must then have been very small in proportion to the evaporation. We are, therefore, rather inclined to attribute the increased duty of the fuel to the increase of the heated surface of the boiler, than the diminution of the rate of combustion. Nevertheless, from other experiments of Mr. Parkes, we are disposed to think that, for economy of fuel, the combustion in the generality of waggon boiler furnaces is rather too rapid. The very large proportion that the heated surface in the Cornish boilers bears to the weight of water evaporated is, no doubt, to a considerable extent, rendered necessary by the thickness of the plates which the heat has to penetrate, and the high temperature of the water within them,—both circumstances that retard the transmission of the heat. The Cornish practice, too, is universally, so far as we have been able to ascertain, in favour of this great extent of surface; yet we can hardly think that a small diminution of it would produce any injurious effect on the economical properties of the boiler, while it would save a considerable part of the original cost.

It will be seen, from what we have already advanced, that but a small part of the superior duty of the Cornish engines can be derived from the boilers; we must therefore look to the engines for the principal sources of their superiority, which may be comprised under these three heads:—

1st. The use of high-pressure steam cut off when a very small part of the stroke has been performed, and working expansively over the remainder.

2nd. The careful clothing of every part of the engine where heat can escape. The cylinder is usually encased with a steam-jacket; and the steam-jacket itself, all the steam-pipes, top of the boiler, &c., are protected from the cold air by being covered with a layer of three or four inches thick of ashes, sawdust, or other good non-conductor of heat. The amount of saving effected in this way may be conceived to be very considerable. We have not met with any experiments to ascertain the amount of the saving by clothing the whole engine; but Mr. Wicksteed found that clothing the top of the boilers *alone* produced a saving of 10½ per cent. in the fuel consumed.

3rd. The third main source of the great duty of the Cornish engines is to be found in the excellent system of registering and publishing the duty of each engine, which has for many years been prevalent in Cornwall. It has made both the proprietors and engineers much more careful than they otherwise would have been of a host of details that have elsewhere been considered too trifling to require notice; but which, nevertheless, in the aggregate, are of no small importance.

Expansion, however, is the grand means by which the Cornish engineers have produced such important results. The general principle by which additional power is gained in this way is now so generally understood, that it is unnecessary to attempt its explanation here, and our space will not allow us to enter into details; we shall therefore content ourselves with giving a table (Table II.) of the performance of *engines* similar to the one we have already given for *boilers*.

TABLE II.	Smeaton's Atmospheric Engine, Long Benton, Northumberland, date 1772.	Bolton and Watt's, non-expansive rotative condensing Engine, Albion Mills, London, date 1786.	Holmbush, Cornish, condensing Engine, single acting for pumping water. Steam acts expansively after the first sixth of the stroke. 1836.	Noncondensing double rative Engine, nonexpansive, Congleton, Cheshire. 1823.	Cornish Engine, East London Water Works.	Bolton & Watt's pumping Engine at East London Water Works.
Diameter of cylinder in inches	52	34	50	13	79¾	59⅝
Length of stroke in feet	7	8	9·1	4	10	7·91
Number of strokes per minute	12	16	4·63	27·5	7	11·5
Pressure on the piston, above or below the atmosphere in lbs., per square inch	......	Estimated at —2·5	+30	+20	+5·17	+2·15
Weight in lbs. raised one foot by 112 lbs. of coals	12,600,000	25,756,752	140,484,848	12,418,560	105,664,118	46,602,333
do. do. by one pound of water, as steam	14,280	28,489	119,097	15,840	110,716	53,369
Effective power of the engine at time of experiment in horses power	40·5	50·0	26·48	12·0	......	
Efficiency of the steam, its efficiency in the Albion Mills being unity	·501	1·000	4·180	·556	3·89	1·87
Efficiency of the fuel, its efficiency in the Albion Mills being unity	·489	1·000	5·454	·482	4·1	1·81
Distance of the piston from the end of its stroke when the steam is cut off in parts of the length of stroke	0	0	·833	0	·687	·5

The first column on the left exhibits the performance of Smeaton's atmospheric engine at Long Benton. In the second column will be found similar particulars of Bolton and Watt's condensing rotatory engine at the Albion Mills. In the third column we have put down the same data for the Holmbush Cornish engine: and, in the fourth, for a high-pressure non-condensing engine, whose duty was determined by Mr. Wicksteed. The last two columns supply the same data for a Cornish engine and Bolton and Watt pumping-engine at the East London Water-works. The economical effects of expansion will be found to be very clearly exhibited in this table. The duties are recorded in the fifth line from the top, and the degree of expansion in the bottom line. It will be observed, that the order in which the different engines stand in respect of superiority of duty, is the same as in respect of amount of expansion. The Holmbush engine has a duty of 140,484,848lbs. raised 1 foot by 1cwt. of coals, and the steam acts expansively over ·830 of the whole stroke; while the water-works' Cornish engine has only a duty of 105,664,118lbs., and expands the steam over only ·687 of the whole stroke. Again; comparing the two Bolton and Watt engines together, the Albion Mills engine has a duty of 25,756,752lbs., and no expansive action. The water-works' Bolton and Watt engine, again, acts expansively over one-half of its stroke, and has an increased duty of 46,602,333lbs. Other causes, of course, may influence these comparisons, especially in the last, where one engine is a double-acting rotatory engine, and the other a single-acting pumping one; but there can be no doubt that the expansive action in the latter is the *principal* cause of its more economical performance.

Our limited space does not admit of our going more into detail, but we have said enough to show the great increase of the effective power of steam that may be accomplished by using it expansively. Many, perhaps most engineers, are already well acquainted with this fact, yet it cannot be denied that, in regard to land-engines especially, non-expansion is the rule, and expansion the very rare exception. However readily the manufacturers of engines may admit in theory the advantages of the latter plan, they are wonderfully slow to adopt it in practice. Those who feel interested in the matter, and desire further information, we would strongly recommend to consult the "Transactions of the Institution of Civil Engineers," and particularly Mr. Parkes's paper in the third volume, which we have already so frequently quoted; where, besides a well-arranged collection of the principal experimental data that have been of late collected on the subject of Cornish engines, they will find some very useful experiments and discussions on boilers generally.

Having said so much in praise of Mr. Parkes's paper, we are sorry that we cannot add that its quality is uniform throughout. The latter part of it is devoted to an examination of the duty performed by a given quantity of fuel in locomotives. He has collected all the experiments of Wood, Pambour, and Lardner, on that subject, and thrown their results into the tabulated form, in the same way that he has treated other kinds of engines; and the result is, that he *thinks* that he is entitled to reject the whole, as being utterly unworthy of credit.

This sweeping sentence is pronounced principally on two grounds,—that the experiments, even by the same person, flatly contradict each other; and, second, that they go to show that a cubic foot of water, as steam, does more effective work in a locomotive than in any other form of engine. Unfortunately for Mr. Parkes's reputation, however, while he was thus zealously engaged in bringing to light the errors of others, he fell into the very common mistake of overlooking his own: and in this part of his paper he has scarcely analyzed a single experiment that he has not misunderstood and perverted, till, towards the end of his paper, he gets involved in such a labyrinth of errors, that extrication is impossible. Mr. Parkes, however, seems not to have been at all aware of the treacherous ground on which he was standing; but, elated with the idea of having effectually demolished the experiments and theories of three authors who had usually been received as authorities, he proceeds with the utmost complacency to build a theory of his own on an entirely new foundation.

The fundamental principle of this new theory is thus enunciated,—"The momentum communicated to the entire mass set in motion, represents the useful mechanical effect exerted by the steam." This is the pith and marrow of the whole affair, and when it is explained that "momentum" here is used in its ordinary sense, to signify the weight of the moving body, multiplied into its velocity, it will be at once perceived that this measure of the power of the engine takes no account of the resistance encountered by the train on the rails. The "momentum," for instance, of the train would be the same, supposing the velocity to be the same, whether it was going *up* an incline or *down* one. It may, therefore, be demonstrated, on Mr. Parkes's momentum principle, that the power expended in driving a train at ten miles an hour *up* an inclined plane, is precisely the same as that expended in pushing it *down* the same plane at the same velocity. Mr. Parkes, however, sees no difficulties or inconsistencies in his way, he proceeds fearlessly to the application of the new theory. He takes all the locomotive experiments he can collect, and multiplies the weight of the train in tons, by the velocity in feet per second. (How he fixes on tons and feet per second, in place of pounds and feet per minute, we cannot comprehend.) The products he puts down in a table, and calls them the momentums, which are the measures of the power of the engine. He then proceeds, with the utmost confidence, to purge the roll of all the erroneous experiments. He assumes that, whenever the weight of a train is increased its velocity must be diminished, (forgetting, of course, that the light train may be going up hill and the heavy one down,) in a greater proportion than the weight was increased. Hence the greater the velocity the less ought the "momentum" to be, the weight being the same, or the greater the weight the greater should the momentum be, and all the experiments that contradict these canons he condemns at once. There are, of course, a considerable number that are condemned by this new code of criminal law, and the judge, in passing sentence, manifests but little feeling for the criminals. It is done with the greatest ease, certainty, and expedition; there are no intricate legal points to be determined. Take a specimen: "A reference to the *Fury* exhibits that engine as having performed more work at 25 than at 21¾ miles per hour (a great crime certainly); it is *therefore* with certainty we may conclude one or both of these experiments to be erroneous." The surpassing excellence of the new method everywhere comes out in strong relief. "I adduce these few comparisons to exhibit the facility and certainty with which they are developed by this method of investigation." "Another instance of the delicacy of this test." "This method of investigation discloses experimental defects as well as errors of fact." If the reader is curious to know more of the theoretical "defects, as well as errors of fact," that abound in this Essay, we beg to refer him to the Introduction to the second edition of Pambour's Treatise on Locomotives, where he will find it tried by such "delicate tests," that very little of it stands the proof.

(*To be continued.*)

TABLE III.

We give the following Table of the comparative evaporative power of different kinds of Coal, from Mr. Wicksteed's Experimental Inquiry. It may be useful in enabling others to compare their own experience as to the qualities of different boilers, with the experiments given in the table above.

	Description of Coals.	Water evaporated per lb. of Coals.	Value per ton in the Pool.
1	The best Welsh	9·493	17 11
2	Anthracite	9·014	17 0
3	The best small Newcastle . . .	8·524	16 1
4	Average small Newcastle . . .	8·074	15 2¾
5	Average Welsh	8·045	15 2¼
6	Coke from Gas-works	7·908	14 11
7	Coke and Newcastle small, ½ and ½ .	7·897	14 10¾
8	Welsh and Newcastle, mixed ½ and ½ .	7·865	14 10
9	Derbyshire and small Newcastle, ½ and ½	7·710	14 6½
10	Average large Newcastle . . .	7·658	14 5½
11	Derbyshire	6·772	12 9¼
12	Blythe Main, Northumberland . .	6·600	12 5½

Art. VIII.—EWBANK'S HYDRAULICS.

A Descriptive and Historical Account of Hydraulic and other Machines for raising Water, Ancient and Modern. Illustrated by nearly three hundred engravings. By Thomas Ewbank. London: Tilt and Bogue. 1842. 8vo., pp. 582.

This is one of the most entertaining books we have read for a long time, and not one of the least instructive. It contains an account of almost all the hydraulic machines and instruments of which history preserves any record, and displays much discrimination, and extraordinary research. At the same time, the work is in some respects more curious than useful; it is deficient in such practical information as the modern hydraulic engineer more particularly requires, and is, upon the whole, too prolix, and sometimes trite and frivolous. We do not, indeed, suppose that in a work of this nature any great deal can be said which has not been said already in some other quarter; and a want of novelty is therefore no valid ground of objection; but what we complain of is, that Mr. Ewbank has occasionally dwelt too long upon things everybody knows;—he has sought to illustrate self-evident truths with too great solicitude, and has sometimes magnified events and objects of little or no consequence into things of unspeakable importance. Mr. Ewbank, we ought to have mentioned, is an American; and his patriotism occasionally shines out in the precedence which he manages to give to the inventions of his countrymen. He is, we have no doubt, a good republican—a considerable despiser of "wealthy dolts, titled buffoons, and royal puppets"—and we verily believe, in spite of such outbursts, an excellent and able man; but, while many of his views in reference to the value of the useful arts are striking, and, in our judgment, incontrovertible, others of them are so grossly overpainted, that they become mere caricatures of reasonable opinion. These faults, however, are neither sufficiently great nor numerous to impair materially the excellence of the work; and Mr. Ewbank is, we think, entitled to especial lenity, both on account of the prejudices of his country and occupation, and the great humility of his pretensions.

The work is divided into five books, of which the first is devoted to the illustration of the devices for raising water, used in primitive and ancient times. This is the worst book of the lot; it is divided into eighteen chapters, of which the first two are particularly bad. We must make a few extracts from this part of the work to illustrate Mr. Ewbank's infelicities. Our readers will smile at the following:—

> "How infinitely various are the materials, sizes, forms, and uses of the hammer! and how indicative are they of the state of society and manners! At first a club, then a rude mallet of wood, next the head formed of stone, and bound to the handles by withes, or by the sinews of animals,—afterwards the heads formed of metal." "What a multitude of interesting circumstances are inseparably connected with its development and early uses; circumstances which, if we were in possession of them, would explain almost all that is dark and mysterious respecting our ancient progenitors. A history of this instrument would embrace the origin and general progress of all the useful arts, and would elucidate the civil and scientific acquirements of man in every age. It would open to our view the public and private economy of the ancients; introduce us into the interior of their workshops, their dwellings, and their temples; it would illustrate their manners, politics, religion, superstitions, &c. In tracing the various purposes to which it was applied, we should become acquainted with all the material transactions in the lives of some ancient individuals, from their birth to their death; and also with the circumstances which led to the rise and fall of empires."

The following about water is, of course, extremely profitable, being a collection of truths of which most readers must be ignorant:—

> "Water is in many respects the most important substance known to man: it is more extensively diffused throughout nature than almost any other. It covers the greater part of the earth's surface, and is found to pervade its interior wherever excavations are made. It enters into every, or nearly every combination of matter, and was supposed by some ancient philosophers to be the origin of all matter; the primordial element of which every object in nature was formed. The mineral kingdom, with its variegated substances and crystallizations; the infinitely diversified and enchanting productions of the vegetable world, and every living being in animated nature, were supposed to be so many modifications of this aqueous fluid. Modern science has shown that it is not a simple substance, but is composed of at least two others, neither of which, it is possible, is elementary.
>
> "Water not only forms part of the bodies of all animals, but it constitutes the greatest portion of their food. Every comfort of civilized or savage life depends more or less upon it, and life itself cannot be sustained without it. If there were no rains or fertilizing dews, vegetation would cease, and every animated being would perish."

Having duly explained the importance and advantages of water, of which it is to be presumed many persons were sceptical, Mr. Ewbank proceeds to inform us that, in barbarous countries, the natives, when they are thirsty, go to the river and drink after the manner of horses and cows. This was the first step, and the next improvement in drinking, Mr. Ewbank proves from Virgil and Ovid, consisted in making use of the hollow of the hand. From this the transition to drinking cups was not difficult, which were the first hydraulic instruments. This important development closes the second chapter. Chapter III. is devoted to the elucidation of vessels for *containing* water, and carries about the same weight of metal as its predecessors. There is something irresistibly ludicrous in these laboriously minute gradations. We can forgive a dash of commonplace, if despatched in a moderate compass; but to devote chapter after chapter to such laborious puerilities is, we think, too great a tax upon the reader's indulgence.

Chap. IV. begins the subject of wells, which is continued with a marked improvement, in chapters V., VI., and VII. From the last of these we must extract an account of some of the most celebrated wells which have been bequeathed to the moderns by the ancients:—

> "Jacob's well is, as every reader of Scripture knows, near Sychar, the ancient *Shechem*, on the road to Jerusalem, and has been visited by pilgrims in all ages. Long before the Christian era, it was greatly revered, and subsequently it has been celebrated on account of the interview which the Saviour had with the woman of Samaria near it. Its location, according to Dr. Clarke, is so distinctly marked by the Evangelist, and so little liable to uncertainty from the circumstances of the well itself, and the features of the country, that if no tradition existed for its identity, the site of it could hardly be mistaken.
>
> "The date of its construction may, for aught that is known to the contrary, extend far beyond the times of Jacob; for we are not informed that it was digged by him. As it is on land which he purchased for a residence, 'of the sons of Hamor the father of Shechem,' and was in the vicinity of a Canaanitish town; it *may* have been constructed by the former owners of the soil, and probably was so. The woman of Samaria, when conversing with the Saviour respecting it, asks 'Art thou greater than our father Jacob, who *gave* us the well, and drank thereof himself, his children and cattle?' John iv. 12. She does not say he dug it. This famous well is *one hundred and five feet deep*, and *nine feet in diameter*, and when Maundrell visited it, it contained fifteen feet of water. Its great antiquity will not appear very extraordinary, if we reflect that it is bored through the solid rock, and therefore could not be destroyed, except by an earthquake or some other convulsion of nature; indeed wells of this description, are the most durable of all man's labours, and may, for aught we know, last as long as the world itself.
>
> "The well *Zemzem*, at Mecca, may be regarded as another very ancient one. It is considered by Mahometans one of the three holiest things in the world, and as the source whence the great progenitor of the Arabs was refreshed when he and his mother left his father's house. 'She saw a well of water, and she went and filled her bottle with water and gave the lad to drink.' Gen. xxi. 19. This well, the Caaba and the black stone, were connected with the idolatry of the ancient Arabs centuries before the time of Mahomet. The Caaba is said to have been built by Abraham and Ishmael, and it is certain that their names have been connected with it from the remotest ages. Diodorus Siculus mentions it as being held in great veneration by the Arabs in his time. [50, B. C.] The ceremonies still performed, of 'encircling the Caaba seven times, kissing the black stone, and drinking of the water of the well Zemzem,' by the pilgrims, were practices of the ancient idolaters, and which Mahomet, as an adroit politician, incorporated into his system, when unable to repress them. The conduct of the pilgrims, when approaching this well and drinking of its water, has direct reference to that of Hagar, and to her feelings when searching for water to preserve the life of her expiring son.
>
> "If we reflect on the infinite value of the wells in Syria—on the jealous care with which they have always been preserved—that while they afforded good water, they could never be lost—that Mecca is one of the most ancient cities of the world, the supposed Mesa of the Scriptures, Gen. x. 30,—and that this well is the only one in the city, whose waters can be drunk:—we cannot but admit the possibility at least, that it is the identical one, as the Arabs contend, of whose waters Ishmael and his mother partook."
>
> "JOSEPH'S WELL.—The most remarkable well ever made by man, is Joseph's well at Cairo. Its magnitude, and the skill displayed in its construction, which is perfectly unique, have never been surpassed. All travellers have spoken of it with admiration.
>
> "This stupendous well is an oblong square, twenty-four feet by eighteen; being sufficiently capacious to admit within its mouth a moderate sized house. It is excavated (of these dimensions), through solid rock, to the depth of 165 feet, where it is enlarged into a capacious chamber, in the bottom of which is formed a basin or reservoir, to receive the water raised from *below*, (for this chamber is not the bottom of the well.) On one side of the reservoir another shaft is continued, 130 feet lower, where it emerges through the rock into a bed of gravel, in which the water is found. The whole depth being 297 feet. The lower shaft is not in the same vertical line with the upper one, nor is it so large, being fifteen feet by nine. As the water is first raised into the basin, by means of machinery, propelled by horses or oxen *within the chamber*, it may be asked, how are these animals conveyed to that depth in this tremendous pit, and by what means do they ascend? It is the solution of this problem that renders Joseph's well so peculiarly interesting, and which indicates an advanced state of the arts, at the period of its construction.
>
> "A spiral passage-way is cut through the rock, from the surface of the ground to the chamber, independent of the well, round which it winds with so gentle a descent, that persons sometimes ride up or down upon asses or mules. It is six feet four inches wide, and seven feet two inches high. Between it and the interior of the well, a wall of rock is left, to prevent persons falling into, or even looking down it, (which in some cases would be equally fatal,) except through certain openings or windows, by means of which it is faintly lighted from the interior of the well: by this passage the animals descend, which drive the machinery that raises the water from the lower shaft into the reservoir or basin, from which it is again elevated by similar machinery, and other oxen on the surface of the ground.
>
> "Opinions respecting the date of this well are exceedingly various. Pococke thought it was built by a vizier named Joseph, 800 years ago; other authorities more generally attribute it to Saladin, the intrepid defender of his country against the hordes of European savages, who, under the name of crusaders, spread rapine and carnage through his land. His name was Yussef, [Joseph.] By the common people of Egypt, it has long been ascribed to the patriarch of that name, and their traditions are often well-founded."

Chapters VIII. to XII. illustrate the modes of drawing water out of wells practised in ancient times, and which consist chiefly of a rope and pulley-wheel and axle, and other such simple expedients. Chapter XII. begins the description of the plans for raising water for irrigation, from which we extract the following:—

> "*The Jantu.*—The jantu is a machine extensively used in Bengal and other parts of India, to raise water for the irrigation of land, and is thus described by Mr. Ward, in his History of the Hindoos. 'It consists of a hollow trough of wood, about fifteen feet long, six inches wide, and ten inches deep, and is placed on a horizontal beam, lying on bamboos, fixed in the bank of a pond or river. One end of the trough rests upon the bank, where a gutter is prepared to carry off the water, and the other end is dipped in the water, by a man standing on a stage, *plunging it in with his foot.* A long bamboo, with a large weight of earth at the farther end of it, is fastened to the end of the jantu near the river, and passing over the gallows before mentioned, poises up the jantu full of water, and causes it to empty itself into the gutter. This machine raises water *three feet*, but by placing a series of them one above another, it may be raised to *any height*, the water being discharged into small reservoirs, sufficiently deep to admit the jantu above to be plunged low enough to fill it.' Mr. Ward observes, that water is thus conveyed over rising ground, to the distance of a *mile* or more. In some parts of Bengal, they have different methods of raising water, '*but the principle is the same.*'"

Chap. XIII. describes the *swape*, an instrument for raising water, used in Egypt from the remotest antiquity, and which consists merely of a beam poised on a centre, and so arranged with a weight at one end, as to balance a bucket full of water at the other. Chap. xiv. begins the account of the wheels for raising water, viz., the scoop wheel, noria, and Persian wheel. Chap. xv. describes the chain of pots still used extensively for raising water in many countries, the rope-pump, and the hydraulic belt, which is merely a variety of the rope-pump, and has been revived of late years, as it appears to us most absurdly, now that so many better hydraulic contrivances exist. Chap. xvi. describes the Archimedes screw, which it appears was not invented by Archimedes at all, but by Conon, a philosopher of Alexandria, who was a contemporary of Archimedes. Chap. xvii. describes the chain-pump, which was introduced from China by the Dutch. The original form of this machine was an inclined shoot, open on the upper side, in which a series of square pieces of wood travelled. This variety of the machine is to be met with in China at the present day. Chap. xviii. treats of the hydraulic works of the early Americans, and especially of the natives of Mexico, Chili, and Peru, whose high attainments in many of the mechanical arts, at the time of their subjugation by the Spaniards, were the subject of universal astonishment. Whether these people possessed hydraulic machines for raising water is now unknown; but their aqueducts, and other works of art, were perhaps not inferior to those of any other people. When Cortes took Tezcuco, he found that the water brought by the aqueducts to the city was distributed in pipes to every house. This chapter concludes Book i.

Book ii. treats of machines for raising water by the pressure of the atmosphere, and commences by telling us that "the earth on which we live is of a globular form, and is enveloped in an invisible ocean of air called the atmosphere." We are at a loss to conceive for whose benefit all this important information is designed, seeing that it cannot convey a single new idea to any graduate of the nursery. This book is made up of descriptions of suction-pumps of different descriptions. Book iii. treats of forcing-pumps. Both of these books are very good, but are better adapted to the general reader than the professional one. Book iv. is chiefly occupied with an historical account of the steam-engine; and the fifth and last book professes to treat of novel devices for raising water. Of these novel devices, however, we do not find one of any moment, in the whole length and breadth of the book, with the exception of an improved syphon of Mr. Ewbank's own invention, which is charged, and made to run, by the mere act of inserting it in the liquid. The way in which this is accomplished is by making the short leg with a trumpet mouth, and inserting the instrument in the liquid with the orifice of the longer leg closed by the finger. The air contained in the instrument will of course keep the liquid from entering; and if the finger be now withdrawn, the liquid will rush into the tube, and its momentum will carry it over the neck. The bend of the neck should be a quick one, so as to obviate the necessity of a large quantity of liquid being required to fill it.

There is one great and extraordinary omission in this work, which will not fail, we think, to strike even the most cursory reader. While it enters with great minuteness into the description of such rude and ineffectual instruments as the *swape* and *jantu*, and has a vast deal to say about the steam-engines of Savery, Newcomen, and others of even a still earlier era, it gives no information whatever respecting *modern* pumping engines—which we presume are now the only ones of any practical moment—and is even silent respecting all such important hydraulic machines as the several varieties of the modern water-wheel and of the turbine. These hydraulic machines are often used for raising water, as well as for turning mills, and we certainly think that a good account of them, and of the different kinds of pumping engines now in use, especially those of the Cornish construction, would have been far more acceptable to most readers than much of the material to which Mr. Ewbank has given a preference. In fact, it is only on a few occasions that Mr. Ewbank has managed to come down, or rather, to come up, to our own times; and his work cannot be looked upon as a vehicle of serious instruction, or an index of modern progress. About one of the most extensively adopted expedients for raising water, namely, the wind-mill, there is absolutely not a word; nor do we find any mention made of the application of the breast-wheel, as a water elevator, so much employed in the drainage of our Lincolnshire fens. The fact is, Mr. Ewbank's book has too much of the odour of the library, and not enough of that of the work-shop; and although it is undoubtedly a work of much merit, that merit is of a description which belongs rather to the laborious compiler than to the accomplished mechanic.

Such, then, are the predominant characteristics of this very laborious and interesting work. In the limits to which we are restricted, it is, of course, impossible to do justice to its merits, which are very many and very great. In the next edition, which we doubt not will be speedily called for, we would recommend Mr. Ewbank to blot out a great deal of the preliminary and elementary part, and to extend the practical part sufficiently to make the work really useful to modern hydraulic engineers. We think, also, the historical part is too long, and should be curtailed; yet it is all so interesting, that we have vainly endeavoured to single out a passage which we should like to see expunged.

Mr. Ewbank is a great stickler for the dignity of the useful arts; and though his views are, no doubt, for the most part just, they sometimes approach the confines of extravagance: as, for instance, in page 4, where he tells us that an account of some of the ancient workshops would have been more interesting than almost "all that ancient philosophers ever wrote, or poets ever sung."

The following is, we think, substantially just, and appears to be the growing opinion of intelligent persons. Our readers will find a striking coincidence between Mr. Ewbank's doctrines and those of one of our correspondents, whose letter is given in the article "Our Club," of the present Number.

> "To poets and writers of romance, the annals of mechanism present unexplored sources of materials. They are mines of the richest ores—fields teeming with the choicest fruits and flowers. Here are to be found incidents as agreeable and exciting in their natures, and as important in their effects, as anything that can be realized by the imagination alone; such, too, as present nothing to offend the finest taste, or conflict with the purest morals. When novelists have worn out the common ground, (and they seem already to have done so;) when mere sentiment grows flat, and the exhibition of the passions become stale; when politics, history, and love are exhausted—works founded on the origin, progress, and maturity of the useful arts will both charm the imagination and improve the judgment of readers. Does an author wish to introduce characters who have left permanent impressions of their genius upon the world? Where can he find them in such variety as in the race of *inventors*? Is he desirous of enriching his pages with singular coincidences, curious facts, surprising results—to fascinate his readers, and cause them to anticipate the end of his pages with regret? Let him detail the circumstances that led to the conception, and accompanied the improvement of those inventions and discoveries that have elevated civilized man above the savage."

We here conclude our extracts, and close this very interesting volume. As a popular work on hydraulics, it is, we think, unrivalled; it brings together the scattered hydraulic records of every age, and weaves them into a narrative which has all the attractions of a historical romance. But in those higher qualities of scientific and practical elucidation which the practical man requires, the work is deficient, and indeed it can have no pretensions to the character of a practical treatise. The woodcuts which illustrate the volume are not of the first quality, and we observe many typographical errors, which cannot have had their origin in mere carelessness. We suspect the book to be of transatlantic manufacture in its mechanical as well as its intellectual components.

Art. IX.—BURY'S LOCOMOTIVES.

Our readers are indebted to the Institution of Civil Engineers for the plate of Messrs. Bury and Co.'s locomotive engine, which accompanies this number, who, with Messrs. Bury and Co.'s concurrence, have furnished us with the drawing. The merits of this description of engine have latterly been fiercely debated. Our limits preclude us from saying a word upon the subject just now, but we shall take an early opportunity of going into the whole question of four and six-wheel engines. In the mean time we may refer our readers to Mr. Herapath's report on this subject. This report has been published in the "Railway Magazine."

Description of Plate V.

The plate represents the merchandize-engine, with cylinders 13 inches diameter, and coupled wheels.

Fig. 1. Is a sectional elevation.
Fig. 2. A sectional plan, the line *x x* showing the principal line of section followed in Fig. 1.
Fig. 3. A transverse section through the smoke-box.

To render the drawing more complete, several parts are shown in each figure which do not come into view on the line of section.

The letters of reference correspond in all the figures.

A. The fire-box.
B. The fire-tubes: there are 96 tubes, 2 inches diameter each, and 9 feet long.
C. The smoke-box.
D. The regulator.
E. The steam-pipe, $3\frac{1}{2}$ inches diameter.
F. The safety-valve and spring pressure-gauge, $2\frac{1}{2}$ inches diameter.
G. The locked-up safety-valve, $2\frac{1}{2}$ inches diameter.
H. The damper.
I. The buffer-bar.
J. The steam-whistle.
L. The steam-cylinders, 13 inches diameter, 18 inches stroke.
M. The force-pumps, plunger 2 inches diameter, 18 inches stroke.
N. The cranked axle; the journals are 5 inches diameter, and 7 inches long: the bearing of each crank is $5\frac{1}{2}$ inches diameter, and $3\frac{1}{2}$ inches long.
O. The connecting-rods, oval-shaped, 2 inches by $2\frac{1}{2}$.
P. The axle of the front wheels, $4\frac{1}{2}$ inches diameter.
Q. The springs. The springs for the cranked axle are composed of 16 plates, together $4\frac{1}{2}$ inches deep at the centre; those for the front axle are composed of 10 plates, together $3\frac{7}{8}$ inches deep at the centre.
a a. The steam-pistons of gun-metal: the packing consists of two rings of cast-iron segments, forced outwards by brass wedges and steel springs. The piston-rods are 2 inches diameter.
b. The inlet passages for the steam, $1\frac{1}{4} \times 6\frac{1}{2}$ inches.
c. The outlet passages for the steam, $1\frac{7}{8} \times 6\frac{1}{2}$ inches.
d. The slide-valves.
d′. The slide-valve rods, 1 inch diameter.
e. The pendulum-rods for carrying the ends of the eccentrics.
f. The shaft to which the eccentric levers are fixed.
g. The shaft connecting the motion of the lever *h*, and the rod *i*, to the shaft.

h. The guides for the piston-rods.
i. Steadying pieces for the guides.
j. Shaft carrying the steadying pieces.
k l. The rods for moving the slide-valves.
k′ l′. The levers of the hand-gear.
m. The shaft carrying the valve trappings.
n. The lever for working the valves.
n′. The lever worked by the eccentrics.
p. The eccentrics for the retrograde motion.
q. The eccentrics for the advancing motion.
r. The pipes (2 inches diameter) connecting the force-pumps with the tenders.
s. The cock for letting the water out of the boilers.
t. The rods (1⅝ inch diameter) for coupling together the front wheels and the driving-wheels.
u. A lead plug at the top of the fire-box.

We subjoin the following remarks by Mr Bury.

"The most essential requisites in a locomotive boiler are, a great extent of heating surface in a small compass, and the arrangement of that surface so as to cause and promote a rapid circulation of the water. These principles have been kept in view in the disposition of the tubes and the shape of the fire-box.

"The central tubes and the centre of the fire-box are nearest to the surface of the water, which is consequently hottest and lightest above those parts, and towards them the particles of water or globules of steam will rush; the outer tubes and sides of the fire-box being lower, and consequently cooler, establish a return current of the colder particles of water from the centre towards the sides and bottom of the boiler.

"This arrangement of the upper row of tubes has also the advantage of preventing any of them from being uncovered when the engine is travelling on sharp curves, where the centrifugal force throws the water to one side of the boiler.

"The fire-box is cylindrical, with its back flattened to receive the ends of the tubes: its top is a sphere merging into a cylinder or elongated cone, and all the curves are such as to enable the plates to resist the pressure of the steam without the assistance of ribs or stays, which so materially prevent the circulation of the water over square fire-boxes. The cylindrical-shaped fire-box possesses a great superiority over a square one, inasmuch as the corners, in which the combustion is always languid, are avoided."

Art. X.—WOOD PAVING.

There are few of our laws, we think, fraught with more momentous consequences to the prosperity of the country than those which relate to patents for inventions. It is to the active ingenuity of our projectors that we must chiefly look to the maintenance of our position in the scale of nations, and anything by which this ingenuity is repressed or discouraged, darkens our future prospects, and inflicts a serious hurt upon our national greatness. To the developement of the resources of our inventors the law of patents is a necessary stimulus; and, indeed, it is but another phase of that more extended law which lies at the root of all society, and which guarantees to every man the enjoyment of the fruits of his labour. There is this difference, it is true, in the case of inventors—the enjoyment of the fruits of his ingenuity is not given in perpetuity. If a man embarks in trade, and expends his skill in establishing beneficial mercantile connexions, or in accumulating property, which brings him in a large revenue, he may bequeath all these things to his descendants; but if he expends his skill in devising some mighty improvement, this property is taken from him in a certain number of years, and given to the public. This would be a manifest injustice, if in every system of legislation it were not necessary to pay regard to the duties of individuals as members of a state, as well as to their rights in the abstract, and those public claims, it would appear, require that, after a certain number of years the property in every patent should be surrendered to the community. Viewed, therefore, merely in regard to the public advantage, the duration of patents should be as brief as possible, consistently with the unrepressed activity of ingenious minds; but the public would manifestly be a loser if the time for which a patent property might be enjoyed were so abbreviated that the advantage of its acquisition would no longer be correspondent to the toil and difficulty of acquiring it. Under circumstances such as these, the talent and energies of our inventors would find other fields for their exercise, and our arts would first become stationary, and afterwards retrograde, to the decay and ruin of our national supremacy.

We think, therefore, that it is of the utmost importance to the State, that inventors should meet with adequate encouragement, both by giving them the possession of their respective inventions for a sufficient period, and by taking care that this possession, once granted, shall not be invaded or trampled upon. In the latter of these provisions the existing laws are defective, for, while they provide a remedy against infringement, that remedy is so expensive, and so unequally administered, as to be attended with much uncertainty, at the same time that it is unattainable by any but the rich and powerful. Many an act of glaring injustice has thus been perpetrated with impunity, and the poor inventor has been robbed of his property, and involved in endless expense and litigation, while a set of powerful and shameless pirates have risen to untold wealth on the ruins of his fond and reasonable anticipations. Such cases, indeed, are now happily more rare than formerly: the necessity of giving adequate encouragement to inventors has become more visible to our legislators and judges, and the claims of patentees, in Courts of Law, are far more favourably entertained than in by-gone times. Public opinion, moreover, will generally set strong against any party convicted of manifest plagiarism; and no respectable person will now, we believe, be found to give the least encouragement to such unprincipled persons as attempt to rob an inventor of the fruits of his perseverance and ingenuity.

One of the most common and effectual expedients for breaking through patents, practised in former times, was the production of evidence to the effect, that they were not new. Some old forgotten book, or manuscript, was raked up, to show that something of a similar description had been proposed before, though never made generally known, or carried out into beneficial practice. Latterly, however, Courts of Law have very properly held that, the first *beneficial* inventor is the person really entitled to the exclusive right: there is, indeed, generally a vast deal more merit in reducing a plan to practice, and urging it into use, against all the obstructions and discouragements new plans invariably receive, than in striking out an idea which may be susceptible of beneficial developement.

These reflections naturally arise out of the introduction of wood paving into this country, and the host of rival pretenders who have sprung up to the merit of that application. It appears incontestable, however, that the system of paving highways with wood, now so extensively practised, was first introduced into this country, for all practically useful purposes, by Mr. David Stead, who, in the year 1838, laid down some wood paving, in Oxford-street, which answered extremely well. In the same year, and antecedently, we believe, to this experiment, Mr. Stead took out a patent for the system of wood paving, which is the first patent for that application of wood to paving purposes.

Long before this time, however, wood blocks had been applied as flooring in stables, court-yards, and other similar places, and so far back as 1825, a Mr. Finlayson proposed to pave some of the streets with wood, but the project was never carried into effect, and never excited any considerable notice. Indeed we have doubts whether the plan proposed by Mr. Finlayson could be readily put in practice, and it certainly would be enormously expensive. In 1832, Mr. James Heard communicated to the Society of Arts a plan of wood paving, he had seen in use at St. Petersburgh, and which answered there very well; but Mr. Heard did not think wood paving would answer at all in the streets of the City of London, through which immense weights are continually being transported.

Up to 1838, then, when Mr. Stead began operations, nothing practically useful had been achieved, and people were very incredulous of wood being susceptible of application to paving purposes. The several vestries to which Mr. Stead applied to make trial of his plan, ridiculed the idea of such an application; and he was looked upon, wherever he went, as an impracticable and hair-brain enthusiast. Undaunted, however, by these discouragements, and with confidence in the feasibility of his project, he persevered in his applications; and at length, on the occasion of laying down a great variety of pavements, in Oxford-street, with the view of testing their relative merits, he obtained permission to put down a small piece of his wood paving. It succeeded to admiration: he got leave to put wood paving down in several other situations, and from that time it has daily been coming into more general use.

As soon as it became manifest that wood paving was a good thing, and would probably be a profitable one, a host of competitors started up, who endeavoured, and not without much temporary success, to wrest from Mr. Stead the emoluments of his project, and in developing which he had spent his time, energy, and means. Mr. Stead's patent was for paving with wooden blocks; and after the wood paving had been found to do, several parties got up, and took patents for particular kinds of wooden blocks:—as if every kind were not comprized in the original definition. The fact is, Mr. Stead's first patent was for the application of wood as a paving material; and, as he appears to be indisputably the first beneficial inventor—the first patentee, and to have carried out his plans adequately in practice, it cannot, we think, be doubted that the proceedings of other wood paving adventurers are dishonest and illegal, and as such are unentitled to the support or countenance of respectable persons.

There was, we believe, some informality in Mr. Stead's first patent, which induced him to take out a second patent, in which he specified a great variety of shapes of blocks which he thought would be suitable for paving purposes, and which are represented in Plate VII. It is manifestly impossible, however, to specify every shape, and it appears to us the best plan in all such affairs is to leave the shapes an open question. Mr. Stead's first patent has since, we understand, been confirmed by a special Act of Parliament, so that the second one becomes, as it were, inexistent.

The shape of the blocks laid down in Oxford-street was the hexagon. To this shape Mr. Stead seems much attached, and we have no reason to believe that it is not a good one, but this is a question which we think should be left to be decided by a more extended experience. There is scarce one of the numerous shapes we have heard proposed which might not, we think, be made to answer very well; so that the question of shape chiefly resolves itself into the questions of cheapness, durability, and facility of removal, so as to get at the gas and water-pipes underneath. We think that the blocks should be all so connected together as to afford mutual support, but they should be, at the same time, capable of being easily raised. Nevertheless, a connexion between the blocks is not necessary, nor, if holes had not to be often dug which, when filled up, afford a surface of inadequate solidity, would this connexion be advisable. But taking into account all the circumstances likely to arise in the case of London paving, we certainly think the blocks should be bound together so as mutually to sustain one another. By this means the necessity of a concrete foundation will be superseded, and a permeable foundation may be obtained, which certainly appears to be highly conducive to the durability of the wood.

The advantages of wood pavement over pavement of every other description are now so generally appreciated, that it would be superfluous to say a word upon the subject. Like all other great improvements, it has encountered a vehement opposition, and latterly Sir Peter Laurie, with a becoming regard to the dignity of timber, has set his face against its desecration by any ignoble use; but in spite of all these obstructions, wood paving is daily coming into more general use, and at no distant period must prevail universally. It is said to have one defect—its slipperiness; and certainly we do believe that in certain states it is somewhat more slippery than stone; but the magnitude of this defect has, we think, been grossly exaggerated, and even were it quite as great as many pretend, it is assuredly susceptible of mitigation. One person suggests the covering of the whole upper surface of the timber with pitch and sand, as is said to be practised in Russia with the most beneficial effects; another suggests that the streets should occasionally be sprinkled with sand, after the same manner as they are now sprinkled with water, a practice already in use upon the railways, to prevent the slipping of the wheels. We scarcely think either of these expedients necessary, and they certainly would not be so were wood paving universal, so as to admit of horses being shod with some description of shoe which might take advantage of the peculiar facilities for preventing slipping which wood paving exclusively offers.

We cannot afford to go at present into a discussion of the relative merits of particular kinds of blocks. We mean, however, on an early occasion to go fully into that question; and we shall only so far anticipate what we shall have then to say as to remark that the hexagon block is in numerous situations the best, but we do not think it is the best universally. Wherever there are no heavy weights to pass over the pavement, and no insecure foundations to provide for, thereby rendering a connexion of the blocks by dowels, or keys, unnecessary, we should give the hexagon block a preference; but in other situations we should prefer the octagon alternated with the small square, and would connect the whole of the octagons together with double dovetail keys, leaving the small square blocks to be removable; but these small square blocks should rest not upon the foundation, but upon the ends of the keys. By this expedient the whole of the octagonal blocks of a street would be connected together in a sort of reticulated framework, so that it would be impossible for any one of them to sink, even if the ground were dug from beneath it. The interstices left by the octagons would be filled by the square plugs, of which the corners would be chamfered off half the way up their sides, so as to afford a support for them on the ends of the keys, and at the same time admit of their being withdrawn. By drawing out the plugs the keys attaching the octagons might be driven out laterally, and the whole of the blocks would thus become disconnected.—We are falling, however, into our old trick of dissertation, and here break off with the remark that no form of block is universally and absolutely the best, and that the selection of the shapes should be governed by the specific requisitions of the situation in which they are to be applied.

EXPLANATION OF PLATE VII.

Figs. 1 and 2 are plan and elevation of hexagonal blocks arranged to suit the curve of the road-way. It will be observed, that these blocks may also be keyed side-ways, in the manner recommended in the case of the octagons. For this purpose a hexagon must be left out, at proper intervals, and when put in must be made to rest not upon the ground, but upon the ends of the keys, or upon projections upon the other blocks.

Figs. 3 and 4 are plan and elevation of square blocks—shaped, in fact, like paving stones.

Fig. 5 is a perspective view of the hexagonal block, so cut that every block supports the next to it, by means of a projecting ledge.

Fig. 6 is a plan of a round block, which may be made of pieces of trees, with smaller pieces jammed between, and the interstices may either be left open for the water to drain off, or filled up, either partially or wholly, with pitch or cement.

Figs. 7 and 8 are a plan and elevation of the octagonal, alternated with the square blocks, of which we have already spoken.

Figs. 9 and 10 represent square blocks, with deep rectangular channels cut in them, to afford footing for the horses.

Figs. 11, 12, 13, and 14, are varieties of shapes, the object of which is to give mutual support.

Fig. 15 is the inclined square, now used by the Metropolitan Wood Paving Company.

These shapes are taken out of an infinite variety of others, specified in Mr. Stead's second patent, and many of them are identical with the shapes for which patents have subsequently been taken out by other parties. There is certainly no discoverable difference between the shape shown in Fig. 15, and that now employed by the Metropolitan Wood Paving Company, and the patent upon which that Company proceeds is of a *later* date than Mr. Stead's patent, from which the above shapes are extracted. The question of shapes, however, is one of trivial importance; they may be multiplied *ad infinitum*, and people will probably never agree as to what shape is the best. The adoption of a parallelopiped instead of a cube, certainly does not involve the supposition of any discovery having been made, or difficulty surmounted, and a grant of a patent, or at least its validity, is based upon the supposition of merit of some kind or description. These shapes will, however, show that the credit, however infinitesimal, of introducing novel shapes, claimed by a host of pretenders, cannot be allowed; and in particular that the career of the Metropolitan Wood Paving Company has been from the first a scandalous and barefaced usurpation.

ART. XI.—FIELD'S CANAL LOCK.

THIS is one of the most elegant contrivances that has ever come under our notice, and is calculated, we conceive, to be of great importance to our system of inland navigation. But apart from all considerations of utility, the refined ingenuity which shines out in this combination, cannot fail to command the applause and admiration of every intelligent mechanic. High as our opinions of Mr. Field's talents have always been, we must honestly confess, that this neglected and isolated invention has raised him to a more elevated position in our estimation, than he before occupied, and constitutes in our judgment an index of capacities, such as his more applauded achievements in the beaten track of improvement have failed to make manifest. In short, this invention clearly shows, that Mr. Field is a man of original genius, as well as a practical and scientific proficient; and the rarity and value of this high gift are prodigiously increased by its association with a calm and ripened judgment, which may restrain its excesses, and direct its inspirations into profitable channels.

Our present concern, however, is not with Mr. Field, but with his invention, of which we must now proceed to lay some account before our readers. A description of it, communicated by Mr. Field himself, was given in the first volume of the Transactions of the Institution of Civil Engineers; but the plan seems never to have excited much attention, and, indeed, a large proportion of our engineers seem insensible to its extraordinary merit. In every new invention, however admirable, there is usually a vast deal of uncertainty, incredulity, and indifference even among professional persons; and, unless forced into notice by active and influential parties, the best scheme in the world may long languish in obscurity. Established engineers find it less troublesome, and more safe, to keep in the beaten track, and if we must tell the whole truth, many of them are incapable of appreciating the merits of an invention such as that under our review.—We were upon the point of saying, that it is only by persons of genius, that the merits of works of genius can be understood; but, we fear that the more uncharitable part of our readers would set down any such assertion as an intended compliment to our own discernment; and we therefore at once leave this dangerous ground, and proceed to the explanation of the invention.

When a lock-full of water is allowed to run out, as much power is manifestly thrown away, as would suffice to refill the lock. Could the stream of water, which issues from the sluice be rendered conveniently available to the working of pumps, a quantity of water equal to that which has run out (with of course some deduction for friction and inadequate effect) would be raised to the former level, and there would be thus little or no waste of water in locks constructed on this plan. But any such machinery attached to the different locks would be expensive, and many very competent judges say that it would soon get into disrepair, from neglect, exposure, and bad treatment. Mr. Field's opinion on such a subject is entitled to weight, and it is as follows:—

> "When the rough usage to which canal locks are subject is considered, and the ignorance of the persons necessarily employed in the management of them, it does not seem probable that any conservative lock will succeed, until the whole apparatus shall be reduced to fixed masonry, and no other machinery employed than common gates, and paddles or sluices; for of all that have been invented, and for which upwards of twenty patents have been granted, none have been brought into practice for any length of time, except those of the side-pond class, which save half the water, and which though less simple than the common lock, consist of the same parts, and are found completely manageable by the persons usually employed on canals."

To this opinion we do not say that we subscribe, but we think it deserving of much weight, as well on account of its intrinsic good sense, as in consequence of the high authority of the person by whom it is given. Mr. Field proceeds to describe the principle of his plan, which consists in taking advantage of the momentum of the column of effluent water to raise it to its former level; so that, in fact, the contrivance operates as a huge hydraulic ram. We must, however, leave Mr. Field to tell his own story:—

> "The method by which I propose to render the descending lock of water available for raising an equal quantity, is, in its simplest form, as follows:—At a suitable distance from any common lock, in any direction, I have a side-pond or basin, of an area or depth equal to the lock, and communicating with it by a large and long culvert, rather under the lower level. The diameter and length of this culvert must be such that it will contain as much water as the lock, and each end of the culvert must be provided with a sluice. The lock being full, or equal to the upper

level, and the side-pond empty, or equal to the lower level, the operation will be as follows:—When the sluice or valve is opened, the head of water in the lock will very gradually put the water contained in the culvert in motion, the velocity accelerating, by the laws which govern the motion of fluids, until the levels of the water in the lock and side-pond coincide: at this time, the column of water in the culvert will have acquired a velocity due to the height fallen, and will continue to move forward with a momentum that will not be destroyed until the water has risen in the side-pond to the height to which it descended in the lock,—abating somewhat for the loss of effect from the friction of the water against the sides of the tunnel, &c. When the water comes to rest, the sluice must be shut, so as to prevent it from flowing back. The converse operation is performed by opening the sluice, when the lock will fill, and the side-pond become empty."

Mr. Field aptly illustrates this action, by comparing it to the swinging of a pendulum, the momentum of which, in its descent, carries the weight up through an equal arc on the opposite side. He also recounts the results of some experiments he made with a model, consisting of two cisterns, five feet long and twenty inches wide, with a communication-pipe of eight inches in diameter, and forty-five feet long. These results are as follows:—

Difference of level, 12 in.:	the water rose in the opposite cistern,	$10\frac{1}{2}$in.
" 8	ditto	$7\frac{5}{8}$
" 6	ditto	$5\frac{7}{8}$
" 4	ditto	$3\frac{15}{16}$

When the sluices at the ends of the pipe were left open, the water continued to oscillate nearly an hour before it came to rest.

To obviate the objection, in practice, to a very long culvert, Mr. Field proposes that the culvert should wind spirally round the side-pond or basin. In the case of a double lock, the culvert might make a long horse-shoe sweep beneath the bed of the canal, so that the one end of it would be connected by a sluice with one lock-chamber, and the other end of it would he connected by a sluice with the other lock-chamber. The principle manifestly admits of a great variety of phases, but those we have given are, it appears to us, the most easily worked out in practice. The saving of water by this lock, if well-constructed, would probably be about nine-tenths of the whole.

Such are some of the particulars of this admirable contrivance. For refined ingenuity, elaborated into extreme simplicity, it takes the precedence of most plans which have come under our notice; and it certainly appears to us susceptible of beneficial practical application. Yet, although the plan has been for many years before the public, no instance has come to our knowledge in which it has been tried,—a circumstance, we conceive, which reflects but little credit upon those who have to do with canal navigation,—especially as Mr. Field has no patent for the invention, but has given it freely to the public. We trust this notice may have some effect in drawing attention to the contrivance: its peculiar features require only to be brought out, that its merits may be appreciated; and the general appreciation of the merits of the plan must bring about its universal adoption.

Art. XII.—THOUGHTS ON COFFER-DAMS.

To most persons who have witnessed the slow and toilsome process of forming coffer-dams, according to the usual practice, it must, we think, have occurred, that the process was susceptible of much simplification, or at least that the desired object might be attained in a much less tedious and expensive manner. The American pile driving machine is a very obvious application, of steam power, to hasten and cheapen the operation of driving the piles, and if piles must be driven, we do not see that a better agent than the American machine can be employed, or that the *modus operandi*, as carried into effect by that contrivance, is susceptible of any material improvement. But it has always appeared to us, that pile driving, to any considerable extent, in the formation of coffer-dams, was, under ordinary circumstances, superfluous, and that the water might be as effectually shut out by some species of construction, which would be easily applicable round any pier or foundation, and which would not only save much time and labour in attaining the desired end, but might after having been taken up from one place be applicable, without further expense, to any other. The way in which we would proceed is as follows:—

We would provide a number of strong cast-iron *screw* piles, with double grooves, cast on each side, so as to admit the ends either of stout planks or strong iron plates being inserted into them. These piles we would screw into the ground, at suitable distances, all around the space from which the water was required to be excluded, taking care that the grooves in each pile ranged in the same line as the grooves in that next to it. Into these grooves we would next drop, horizontally, either planks or plates of iron, and in the intervening space, between the inside and outside walls of planks or plates, we would introduce clay-puddle, so as to keep the joints from leaking. The lowermost rows of these horizontal planks or plates would, of course, require to be sharpened, and be forced sufficiently deep into the ground to prevent the water from oozing in underneath them; and if planks were chosen, they would manifestly require to be shod with iron. These and other details, which would occur as being necessary to any one about to adopt the plan, it is unnecessary to enter upon more specifically.

We do not think that this description of coffer-dam would be applicable in all situations; in cases where the subsidiary strata were partly of clay and partly of rock it manifestly would not do; and in the case of clay interspersed with boulder stones, the forcing of the lowermost tier of planks or plates, to a sufficient depth, might be attended with some difficulty. In this case it would probably be necessary to precede the depression of the lowermost planks or plates, by making a deep cut in the earth for their reception. This cut might, we conceive, be made by a suitable chisel, or saw. For the lower tier of the sides of the dam, or those entering the ground, it would, we think, be expedient to use iron in all cases, whatever material were employed above. The iron plates would be more easily forced in, and more easily withdrawn, and when withdrawn would leave but a very narrow channel to be filled up; whereas if the channel were very wide, the lateral extension of the earth beneath the fabric, which would thus be permitted, and its consequent depression, might endanger the stability of the structure. The screwing in of the piles, and forcing in of the plates, might best be accomplished, we think, by means of a hydraulic press.

We do not pretend that this method of forming coffer-dams by iron piles and plates is new. The late Mr. Ewart, of Woolwich, so long ago as 1822, took out a patent for forming coffer-dams by iron plates held together by cramps; and the late Mr. Mathews, of Bridlington, even anteriorly to that date, had used cast-iron sheet piles in laying the foundations of one of the piers of Bridlington harbour. Iron sheet-piles have, moreover, been extensively used for wharf-walls, and other similar purposes. The Brunswick wharf at Blackwall, for example, has an iron front; and many other cases might be mentioned of this application of iron plates and piles; but we are not aware of any case where the particular combination we have recommended of plates or planks with *screw*-piles, has been tried; and it is, in our judgment, preferable in many respects to all others. Cast-iron piles, if driven with a ram, are very liable to get broken; and it is, moreover, difficult, when driving an isolated pile, to keep it straight. These objections do not apply, to the same extent, to the screw-pile, particularly if a hole has been first bored for its insertion, which should, we think, be generally done.

We shall close these loose and rather superficial observations by a description of a coffer-dam invented by Mr. David Stevenson, of Edinburgh, for excavating rock out of the river Rihble; and which might, we conceive, be applied, in conjunction with the plan we have suggested, in those cases where excavations have to be made partly in rock, and partly in earth or clay.

"The cofferdam consists of a double row of iron rods 2½ inches in diameter, placed 3 feet apart, the spaces between the rods which form each row being 3 feet also. On the inner side of each row of rods, linings of three inch Memel planking are placed; and the space between these linings of planking which form the two sides of the cofferdam is carefully filled with well wrought clay-puddle. The sides of the dam are kept together by bars of iron connected to two horizontal wale pieces of Memel timber, measuring 10 inches by 6 inches, placed on the outside of the iron rods. These iron bars pass horizontally through the heart of the puddle at proper intervals, and serve to counteract the tendency which the puddle exerts to force the iron rods and planking outwards, and thus to derange the whole structure. A row of strong stays, placed 18 feet apart from centre to centre, as shown in the Plate, is also applied in the inside of the dam. To avoid interrupting the navigation, as well as for greater safety, the dams were stayed entirely from the inside. These stays, as shown in the drawing, have joints at the upper extremities, and being simply slipped over the tops of the iron rods, and kept in their places by *cotters*, their lower ends, which rest on the bottom, can be moved either horizontally or vertically, and thus be easily adapted to the level of the rock. The shorter stays applied in the first instance can be removed as the work proceeds by simply driving out the *cotters* at the tops of the iron rods, and their places supplied by longer stays resting on the bottom of the excavation. A sluice, at the level of low water, which can be opened so as to admit the water and prevent the dangerous consequences of a sudden rising of the river while the interior of the dam is empty, two cast iron pumps of 12 inches bore, with their gearing, and a steam engine of 10 horses-power for pumping the dams dry, complete the whole apparatus.

"In constructing the dams according to this design, the most tedious parts of the operation were those of fixing the iron rods into the bed of the river, and securing the lower tier of planking which rested on the irregular surface of the rock. The manner in which these operations were effected I shall endeavour briefly to explain.

"In order to fix the iron rods, a jumper point was first worked on the end of each of them. They were then successively *jumped* into the bed of the river to depths varying from 12 inches to 18 inches, according to the soundness or hardness of the rock, by labourers who worked from punts moored in the line of the dam, three or four men being employed at each rod. Gauges were used for enabling the workmen to *enter* the rods properly, so that they might retain a nearly perpendicular position when fixed, and also for the purpose of preserving the proper line of the dam and placing the rods at equal distances apart. No other fixture than that produced by simply jumping the rods into the rock was applied, but this was necessarily a tedious process, from the difficulty of working in a rapid run of water, and from the repeated interruptions which occurred, occasioned by the rise of the tides and by land floods. When a sufficient length of rods had been fixed in the manner described, the lower tiers of planking, which were to be placed below the level of the water, were secured to the iron rods by clasps of iron, as shown in the drawings, and slipped down into their places one above another. The under edge of the lowest tier of planking, the fitting of which often occasioned much trouble, was cut, previously to being put down, as nearly as possible to suit the inequalities of the rock, which were ascertained approximately by measuring from the surface of the water down the iron rods to the bed of the river. The plank being then lowered into its place, a small iron rod, with a hooked end which could go under the plank, was used for finding what parts of it did not touch the rock, and this having been ascertained, the plank was raised and again cut. This operation was repeated two or three times until a near approach to the contour of the rock was obtained. The lower edge of the plank was then cut with the adze in a bevelled or wedge-shaped form, and the plank, being finally lowered into its place in the bottom, was beaten down by blows from a heavy mallet upon an upright piece of wood resting on the upper edge of the plank, and extending above the surface of the water, and the sharp bevelled edge yielding to the blows, sank into the smaller irregularities of the rock, and thus ultimately, as experience proved, formed, in connexion with the puddle behind it, a perfectly water-tight joint. The planks above low water had no fixture to the iron rods, and were kept in their places simply by the pressure of the puddle in the inside of the dam."

This contrivance is, we think, ingenious and judicious; but we value it chiefly as an exponent of the disposition to introduce new devices into works of construction, which, we must say, we too rarely see manifested.

ART. XIII.—ANATOMY OF THE STEAM ENGINE. No. 2.

SLIDE-VALVES.

THE most common description of slide-valves are the D, the three-ported, and the cylindrical. The three-ported valve is mostly used for small high-pressure engines. The cylindrical variety has never come into very extended use, and almost all rotative engines, of any considerable size, whether land or marine, are fitted with the D valve.

Of the D valve there are two varieties—the long and short. For the largest description of engines the short D valves seem preferable, and are generally employed; whereas for the smaller kind the long D variety is the most common. For all engines above 100 horses power we should prefer the short D.

Each valve of the short D construction consists, of course, of two parts, which are joined together by rods. When the valve is small a single rod is sufficient, but for all valves pertaining to engines of more than 100 horses power, the junction should, we think, be accomplished by not less than three rods, and these should not be arranged in a row, but at the points of a triangle. Where two rods only are used in large valves, the upper portion of the valve in particular is apt to spring back from the face and wear into a taper form, and if the valve be in the least taper, it will manifestly be impossible to keep it tight, and it will cut away the packing very rapidly. The rods connecting the upper and under portions of all D valves should, we think, be zincked before their insertion; when left without any defence against corrosion they will waste away very quickly in most cases.

Messrs. Boulton and Watt, and Maudslay and Miller, make their short D valves of brass, for marine engines, but most other engineers, we believe, make them of iron, faced with brass. It has always been a contested point, whether the cylinder or valve faces should be of brass, or whether, in opposition to the received doctrine of identical metals never working so well upon one another, both should be of brass. There is much to be said in favour of all the plans—but we shall reserve what we have to say upon that subject until we come to speak of cylinders.

There are two modes of packing D valves; the one by the introduction of a band of hemp, through a door in the valve casing, and which is pressed against the back of the valve by blocks and screws; and the other, by the introduction of a gasket, between the back of the valve and the valve casing, which is squeezed down by a semicircular junk ring, in precisely the same way as a hemp piston packing. The former of these plans is, we think, the best, and is now that most generally practised. Until recently, Messrs. Maudslay followed the latter practice, but in their recent engines they have, we understand, abandoned it, in favour of the plan of putting in the packing from the back of the casing, with doors opposite to it.

ART. XIV.—PHYSIOLOGY OF THE STEAM ENGINE. No. 2.

SLIDE-VALVES.

IN our last Number we gave, under this head, several formulas and rules to elucidate the working of the slide-valve; and although these are sufficient to enable the engineer to solve any question that is likely to arise in practice concerning it, it has been suggested to us from various quarters, that it is of great importance to the practical engineer to be able to get the information he requires with as little calculation as possible; and we have therefore drawn up three tables, computed from the formulas in our last Number. By means of these tables, the proper dimensions of the cover and length of stroke may be determined, in almost every case, with scarcely any calculation at all.

From an examination of the formulas in our last article on this subject, it will be perceived (supposing that there is no lead) that the part of the stroke where the steam is cut off, is determined by the proportion which the cover on the steam side bears to the length of the stroke of the valve: so that in all cases where the cover bears the same proportion to the length of the stroke of the valve, the steam will be cut off at the same part of the stroke of the piston.

In the first line, accordingly, of Table I., will be found eight different parts of the stroke of the piston designated; and directly below each, in the second line, is given the quantity of cover requisite to cause the steam to be cut off at that particular part of the stroke. The different sizes of the cover are given in the second line, in decimal parts of the length of the stroke of the valve; so that, to get the quantity of cover corresponding to any of the given degrees of expansion, it is only necessary to take the decimal in the second line, which stands under the fraction in the first, that marks that degree of expansion, and multiply that decimal by the length you intend to make the stroke of the valve. Thus, suppose you have an engine in which you wish to have the steam cut off when the piston is a quarter of the length of its stroke from the end of it, look in the first line of the table, and you will find in the third column from the left, $\frac{1}{4}$. Directly under that, in the second line, you have the decimal, ·250. Suppose that you think 18 inches will be a convenient length for the stroke of the valve, multiply the decimal ·250 by 18, which gives $4\frac{1}{2}$. Hence we learn, that, with an 18-inch stroke for the valve, $4\frac{1}{2}$ inches of cover on the steam side will cause the steam to be cut off when the piston has still a quarter of its stroke to perform.

Half the stroke of the valve must always be *at least* equal to the cover on the steam side added to the breadth[*] of the port; consequently, as the cover,[*] in this case, must be $4\frac{1}{2}$ inches, and as half the stroke of the valve is 9 inches, the breadth of the port cannot be more than $(9 - 4\frac{1}{2} = 4\frac{1}{2})$ $4\frac{1}{2}$ inches. If this breadth of port is not enough, we must increase the stroke of the valve; by which means we shall get both the cover and the breadth of the port proportionally increased. Thus, if we make the length of valve-stroke 20 inches, we shall have for the cover $·250 \times 20 = 5$ inches, and for the breadth of the port $10 - 5 = 5$ inches.

TABLE I.

Distance of the piston from the termination of its stroke, when the steam is cut off, in parts of the length of its stroke..................	$\frac{8}{24}$ or $\frac{1}{3}$	$\frac{7}{24}$	$\frac{6}{24}$ or $\frac{1}{4}$	$\frac{5}{24}$	$\frac{4}{24}$ or $\frac{1}{6}$	$\frac{3}{24}$ or $\frac{1}{8}$	$\frac{2}{24}$ or $\frac{1}{12}$	$\frac{1}{24}$
Cover on the steam side of the valve, in decimal parts of the length of its stroke	·289	·270	·250	·228	·204	·177	·144	·102

This table, as we have already intimated, is computed on the supposition that the valve is to have no lead; but, if it is to have lead, all that is necessary is, to subtract half the proposed lead from the cover found from the table, and the remainder will be the proper quantity of cover to give to the valve. Suppose that, in the last example, the valve was to have $\frac{1}{4}$ inch of lead, we would subtract $\frac{1}{8}$ inch from the 5 inches found for the cover by the table: that would leave $4\frac{7}{8}$ inches for the quantity of cover that the valve ought to have.

Table II. is an extension of Table I., for the purpose of obviating, in most cases, the necessity of even the very small degree of trouble required in multiplying the stroke of the valve by one of the decimals in Table I. The first line of Table II. consists, as in Table I., of eight fractions, indicating the various parts of the stroke at which the steam may be cut off. The first column on the left hand consists of various numbers that represent the different lengths that may be given to the stroke of the valve, diminishing, by half-inches, from 24 inches to 3 inches. Suppose that you wish the steam cut off at any of the eight parts of the stroke indicated in the first line of the table (say at $\frac{1}{6}$th from the end of the stroke,) you find $\frac{1}{6}$ at the top of the sixth column from the left. Look for the proposed length of stroke of the valve (say 17 inches) in the first column on the left. From 17, in that column, run along the line towards the right, and in the sixth column, and directly under the $\frac{1}{6}$ at the top, you will find 3·47, which is the cover required to cause the steam to be cut off at $\frac{1}{6}$th from the end of the stroke, if the valve has no lead. If you wish to give it lead (say $\frac{1}{4}$ inch,) subtract the half of that, or $\frac{1}{8} = ·125$ inch from 3·47, and you will have $3·47 - ·125 = 3·345$ inches, the quantity of cover that the valve should have.

To find the greatest breadth that we can give to the port in this case, we have, as before, half the length of stroke, $8\frac{1}{2} - 3·345 = 5·155$ inches, which is the greatest breadth we can give to the port with this length of stroke. It

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[*] By the "breadth" of the port, we mean its dimension in the direction of the valve's motion; in short, its perpendicular depth when the cylinder is upright. The words "cover" and "lap" are synonymous.

TABLE II.

Length of the stroke of the valve in inches.	Cover required on the steam side of the valve to cut the steam off at any of the under-noted parts of the stroke.							
	$\frac{1}{3}$	$\frac{7}{24}$	$\frac{1}{4}$	$\frac{5}{24}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{24}$
24	6·94	6·48	6·00	5·47	4·90	4·25	3·47	2·45
23½	6·79	6·34	5·88	5·36	4·79	4·16	3·39	2·39
23	6·65	6·21	5.75	5·24	4·69	4·07	3·32	2·34
22½	6·50	6·07	5·62	5·13	4·59	3·98	3·25	2·29
22	6·36	5·94	5·50	5·02	4·49	3·89	3·13	2·24
21½	6·21	5·80	5·38	4·90	4·39	3·80	3·10	2·19
21	6·07	5·67	5·25	4·79	4·28	3·72	3·03	2·14
20½	5·92	5·53	5.12	4·67	4·18	3·63	2·96	2·09
20	5·78	5·40	5·00	4·56	4·08	3·54	2·89	2·04
19½	5·64	5·26	4·87	4·45	3·98	3·45	2·82	1·99
19	5·49	5·13	4·75	4·33	3·88	3·36	2·74	1·94
18½	5·34	4·99	4·62	4·22	3·77	3·27	2·67	1·88
18	5·20	4·86	4·50	4·10	3·67	3·19	2·60	1·83
17½	5·06	4·72	4·37	3·99	3·57	3·10	2·53	1·78
17	4·91	4·59	4·25	3·88	3·47	3·01	2·45	1·73
16½	4·77	4·45	4·12	3·76	3·36	2·92	2·38	1·68
16	4·62	4·32	4·00	3·65	3·26	2·83	2·31	1·63
15½	4·48	4·18	3·87	3·53	3·16	2·74	2·24	1·58
15	4·33	4·05	3·75	3·42	3·06	2·65	2.16	1·03
14½	4·19	3·91	3·62	3·31	2·96	2·57	2·09	1·48
14	4·05	3·78	3·50	3·19	2·86	2·48	2·02	1·43
13½	3·90	3·64	3·37	3·08	2·75	2·39	1·95	1·37
13	3·76	3·51	3·25	2·96	2·65	2·30	1·88	1·32
12½	3·61	3·37	3·12	2·85	2·55	2·21	1·80	1·27
12	3·47	3·24	3·00	2·74	2·45	2·12	1·73	1·22
11½	3·32	3·10	2·87	2·62	2·35	2·03	1·66	1·17
11	3·18	2·97	2·75	2·51	2·24	1·95	1·58	1·12
10½	3·03	2·83	2·62	2·39	2·14	1·86	1·51	1·07
10	2·89	2·70	2·50	2·28	2·04	1·77	1·44	1·02
9½	2·65	2·56	2·37	2·17	1·93	1·68	1·32	·96
9	2·60	2·43	2·25	2·05	1·84	1·59	1·30	·92
8½	2·46	2·29	2·12	1·94	1·73	1·50	1·23	·86
8	2·31	2·16	2·00	1·82	1·63	1·42	1·15	·81
7½	2·16	2·02	1·87	1·71	1·53	1·33	1·08	·76
7	2·02	1·89	1·75	1·60	1·43	1·24	1·01	·71
6½	1·88	1·75	1·62	1·48	1·32	1·15	·94	·66
6	1·73	1·62	1·50	1·37	1·22	1·06	·86	·61
5½	1·58	1·48	1·37	1·25	1·12	·97	·79	·56
5	1·44	1·35	1·25	1·14	1·02	·88	·72	·51
4½	1·30	1·21	1·12	1·03	·92	·80	·65	·46
4	1·16	1·08	1·00	·91	·82	·71	·58	·41
3½	1·01	·94	·87	·80	·71	·62	·50	·35
3	·86	·81	·75	·68	·61	·53	·44	·30

is scarcely necessary to observe that it is not at all essential that the port should be so broad as this; indeed, where great length of stroke in the valve is not inconvenient, it is always an advantage to make it travel farther than is just necessary to make the port full open; because, when it travels farther, both the exhausting and steam ports are more quickly opened, so as to allow greater freedom of motion to the steam.

The manner of using this table is so simple, that we need not trouble the reader with more examples. We pass on, therefore, to explain the use of Table III.

Suppose that the piston of a steam-engine is making its downward stroke, that the steam is entering the upper part of the cylinder by the upper steam-port, and escaping from below the piston by the lower exhausting-port; then, if (as is generally the case) the slide-valve has some cover on the steam side, the upper port will be closed before the piston gets to the bottom of the stroke, and the steam above then acts expansively, while the communication between the bottom of the cylinder and the condenser still continues open, to allow any vapour from the condensed water in the cylinder, or any leakage past the piston, to escape into the condenser; but, before the piston gets to the bottom of the cylinder, this passage to the condenser will also be cut off by the valve closing the lower port. Soon after the lower port is thus closed, (see article in our last) the upper port will be opened towards the condenser, so as to allow the steam that has been acting expansively to escape. Thus, before the piston has completed its stroke, the propelling power is removed from behind it, and a resisting power is opposed before it, arising from the vapour in the cylinder, which has no longer any passage open to the condenser. It is evident, that if there is no cover on the exhausting side of the valve, the exhausting port before the piston will be closed, and the one behind it opened, at the same time; but, if there is any cover on the exhausting side, the port before the piston will be closed before that behind it is opened; and the interval between the closing of the one, and opening of the other, will depend on the quantity of cover on the exhausting side of the valve. Again, the position of the piston in the cylinder, when these ports are closed and opened respectively, will depend on the quantity of cover that the valve has on the steam side. If the cover is large enough to cut the steam off when the piston is yet a considerable distance from the end of its stroke, these ports will be closed and opened at a proportionably early part of the stroke; and when it is attempted to obtain great expansion by the slide-valve alone, without an expansion-valve, considerable loss of power is incurred from this cause.

Table III. is intended to show the parts of the stroke where, under any given arrangement of slide-valve, these ports close and open respectively, so that thereby the engineer may be able to estimate how much of the efficiency of the engine he loses, while he is trying to add to the power of the steam by increasing the expansion in this manner. In the table, there are eight double columns, and at the heads of these columns are eight fractions as before, representing so many different parts of the stroke at which the steam may be supposed to be cut off.

In the left-hand single column in each double one, are four decimals which represent the distance of the piston (in terms of the length of its stroke) from the end of its stroke when the exhausting-port before it is opened, corresponding with the degree of expansion indicated by the fraction at the

TABLE III.

Cover on the exhausting side of the valve in parts of the length of its stroke.	Steam cut off at 1-3rd from the end of the stroke.		Steam cut off at 7-24ths from the end of the stroke.		Steam cut off at 1-4th from the end of the stroke.		Steam cut off at 5-24ths from the end of the stroke.		Steam cut off at 1-6th from the end of the stroke.		Steam cut off at 1-8th from the end of the stroke.		Steam cut off at 1-12th from the end of the stroke.		Steam cut off at 1-24th from the end of the stroke.	
	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port before it is shut (in parts of the stroke.)	Distance of the piston from the end of its stroke, when the exhausting-port behind it is opened (in parts of the stroke.)
1-8th	·178	·033	·161	·026	·143	·019	·126	·012	·109	·008	·093	·004	·074	·001	·053	·001
1-16th	·130	·060	·118	·052	·100	·040	·085	·030	·071	·022	·058	·015	·043	·008	·027	·002
1-32nd	·113	·073	·101	·066	·085	·051	·069	·042	·053	·033	·043	·023	·033	·013	·024	·004
0	·092	·092	·082	·082	·067	·067	·055	·055	·043	·043	·033	·033	·022	·022	·011	·011

top of the double column and the cover on the exhausting side opposite to these decimals respectively in the left-hand column. The right-hand single column in each double one contains also each four decimals, which show in the same way at what part of the stroke the exhausting-port behind the piston is opened. A few examples will, perhaps, explain this best.

Suppose we have an engine in which the slide-valve is made to cut the steam off when the piston is 1-3rd from the end of its stroke, and that the cover on the exhausting side of the valve is 1-8th of the whole length of its stroke. Let the stroke of the piston be 6 feet, or 72 inches. We wish to know when the exhausting port before the piston will be closed, and when the one behind it will be opened. At the top of the left-hand double column, the given degree of expansion (1-3rd) is marked, and in the extreme left column we have at the top the given amount of cover (1-8th.) Opposite the 1-8th, in the first double column, we have ·178 and ·033, which decimals, multiplied respectively by 72, the length of the stroke, will give the required positions of the piston, thus 72 × ·178 = 12·8 inches = distance of the piston from the end of the stroke when the exhausting port *before* the piston is shut; and 72 × ·033 = 2·38 inches = distance of the piston from the end of its stroke when the exhausting port behind it is opened.

To take another example. Let the stroke of the valve be 16 inches, the cover on the exhausting side $\frac{1}{2}$ inch, the cover on the steam side $3\frac{1}{4}$ inches, the length of the stroke of the piston 60 inches. It is required to ascertain all the particulars of the working of this valve. The cover on the exhausting side is evidently $\frac{1}{32}$nd of the length of the valve stroke. Again, looking at 16 in the left hand column of Table II., we find in the same horizontal line 3·26, or very nearly $3\frac{1}{4}$ under $\frac{1}{6}$ at the head of the column, thus showing that the steam will be cut off at $\frac{1}{6}$th from the end of the stroke. Again, under $\frac{1}{6}$ at the head of the fifth double column from the left in Table III., and in a horizontal line with $\frac{1}{32}$ in the left hand column, we have ·053 and ·033. Hence, ·053 × 60 = 3·18 inches = distance of the piston from the end of its stroke when the exhausting port before it is shut, and ·033 × 60 = 1·98 inches = distance of the piston from the end of its stroke when the exhausting port behind it is opened. If in this valve the cover on the exhausting side were increased (say to 2 inches, or $\frac{1}{8}$th of the stroke,) the effect would be to make the port before the valve be shut sooner in the proportion of ·109 to ·053, and the port behind it later in the proportion of ·008 to ·033, (see Table III.) Whereas, if the cover on the exhausting side were removed entirely, the port before the piston would be shut and that behind it opened at the same time, and (see bottom of fifth double column, Table III.) the distance of the piston from the end of its stroke at that time would be ·043 × 60 = 2·58 inches.

An inspection of Table III. shows us the effect of increasing the expansion by the slide valve in augmenting the loss of power occasioned by the imperfect action of the eduction passages. Referring to the bottom line of the Table, we see that the eduction passage before the piston is closed, and that behind it opened, (thus destroying the whole moving power of the engine,) when the piston is ·092 from the end of its stroke, the steam being cut off at $\frac{1}{3}$rd from the end. Whereas, if the steam is only cut off at $\frac{1}{24}$th from the end of the stroke, the moving power is not withdrawn till only ·011 of the stroke remains uncompleted. It will also be observed that increasing the cover on the exhausting side has the effect of retaining the action of the steam longer *behind* the piston, but it at the same time causes the eduction port *before* it to be closed sooner.

A very cursory examination of the action of the slide valve is sufficient to show that the cover on the steam side should always be greater than on the exhausting side. If they are equal, the steam would be admitted on one side of the piston at the same time that it was allowed to escape from the other; but universal experience has shown that when this is the case a very considerable part of the power of the engine is destroyed by the resistance opposed to the piston, by the exhausting steam not getting away to the condenser with sufficient rapidity. Hence we see the necessity of the cover on the exhausting side being always less than the cover on the steam side; and the difference should be the greater the higher the velocity of the piston is intended to be, because the quicker the piston moves the passage for the waste steam requires to be the larger, so as to admit of its getting away to the condenser with as great rapidity as possible. In locomotive or other engines, where it is not wished to expand the steam in the cylinder at all, the slide valve is sometimes made with very little cover on the steam side; and in these circumstances, in order to get a sufficient difference between the cover on the steam and exhausting sides of the valve, it may be necessary not only to take away all the cover on the exhausting side, but to take off still more, so as to make both exhausting passages be, in some degree, open, when the valve is at the middle of its stroke. This, accordingly, is sometimes done in such circumstances as we have described; but, when there is even a small degree of cover on the steam side, this plan of taking *more than all* the cover off the exhausting side ought never to be resorted to, as it can serve no good purpose, and will materially increase an evil we have already explained; viz., the opening of the exhausting port behind the piston before the stroke is nearly completed.

N.B. The Tables in this article apply equally to the common short slide three ported valves and to the long D valves.

Art. XV.—ANALYSIS OF BOOKS.

A Synopsis of Practical Philosophy alphabetically arranged. By the Rev. John Carr, M.A., late Fellow of Trinity College, Cambridge. London: John Weale, 1843.

This is not a new book; it was published about ten years ago, and was supposed to be out of print, but in turning out a large bookseller's stores preparative to a sale of the effects, a number of copies were discovered, and were bought by the present publisher, who by a new title page has managed to make the work ten years younger. It is not the worse for this, however, the subjects upon which it treats being those which have undergone scarce any alteration for the last century—and it is much cheaper in consequence. The work is a most excellent scientific remembrancer, containing in a very narrow compass a good explanation of the most important doctrines in natural philosophy, and the alphabetical arrangement greatly facilitates reference.

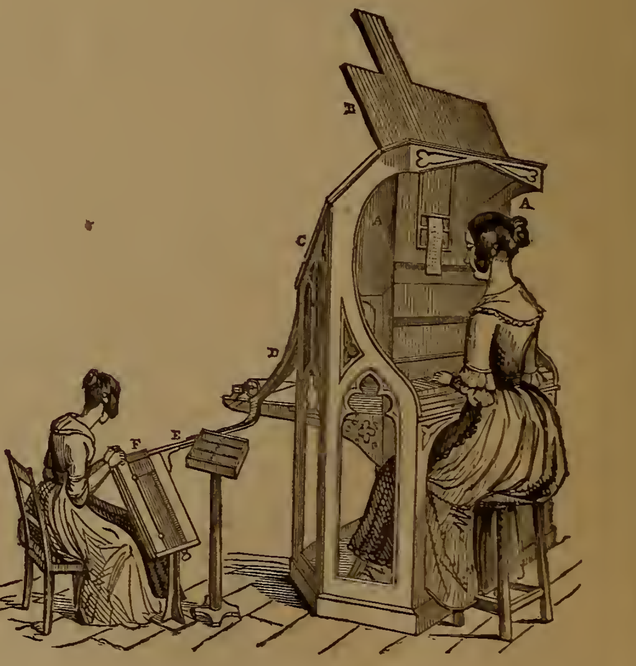
The Year Book of Facts in Science and Art, exhibiting the most important discoveries and improvements of the past Year. London: Tilt and Bogue, 1843.

This very useful compilation, is no doubt known to most of onr readers: it is a mechanical annual, which recounts the most interesting events in practical science of the past year, and is a very elaborate, and upon the whole a very well executed production. We think, however, that too great a confidence is in some instances put in the statements of newspapers and magazines, and some of the *facts* are in consequence not true—unless, indeed, the said facts be taken to refer to the reality of the quotation, and not to the truth of the circumstance recorded. Things which are not quite certain, should, we think, be introduced with a notification to that effect, by which means the work would rise to a higher position, and become an extremely valuable record. The authorities, however, for the several averments are furnished, by which means the public are enabled to judge of their respective claims to credibility.

The contents of the work are arranged under the several heads of Mechanical and Useful Arts, Natural Philosophy, Electrical Science, Chemical Science, Natural History, Geology, and Astronomical and Meterological Phenomena; and winds up with an obituary of persons eminent in Science and Art. This arrangement is, we think, extremely judicious, and the work is upon the whole skilfully executed, and exceedingly useful. We give the following extracts:—

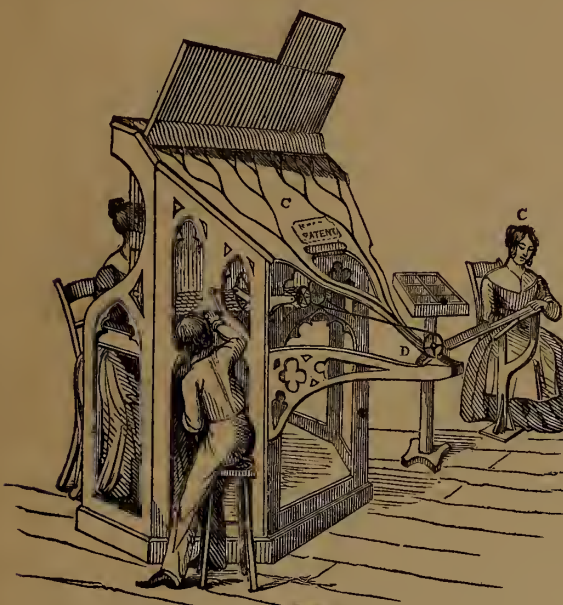
"*Young and Delcambre's Printers' Composing Machine.*—This apparatus is similar in principle to that brought out about a year and a half previously by the same parties, and described in the *Year-book of Facts*, 1842, p. 22. It has, however, been so simplified and improved in all its details, as to be, in effect, quite a new machine.

Fig. 1.



"The accompanying engravings represent the machine at work. Fig. 1 is a front view of it; fig. 2 a back view. It much resembles a cottage pianoforte divested of its case; and it has a set of keys, at which the compositor is seated. Of these keys there are as many as there are letters of the alphabet, and varieties of these letters likely to be required, with a due accompaniment of numerals, spaces, doubles, &c. Each key has one particular letter or character engraved upon it. Attached to these keys are an equal number of upright steel leaves, A A, which are connected at the top with a series of long brass channels, B B, filled with types, each of the sort corresponding with that marked on the key of the lever in connexion with it. The office of the lever is to abstract from the channel above one type every time it is acted on by the depression of the key; and to check the precipitating tendency of the types, which might interfere prejudicially with the action of the lever, the channels are placed in a position considerably inclined, and the lever made to act sidewise in detaching the lowest type of the column. Behind the channels, and at right angles with them, there is an inclined plane, C, which has a series of curved grooves cut out in its surface, corresponding and communicating with that of the channels—all leading to one general reservoir, or receiving spout, as it is called, at bottom, D; and all so nicely curved and graduated, in respect to one another, that, work as fast as the compositor may, when a type is once liberated from its channel, and dispatched down one of these grooves, it is impossible, (except from some accidental circumstance,) for any subsequently liberated type to reach the goal before it."

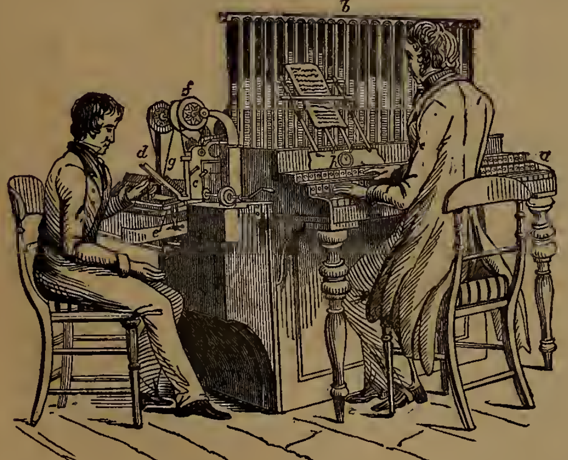
Fig. 2.



" *Rosenberg's Type Composing and Distributing Machines.*—These machines, invented and patented by Captain Rosenberg, are an advance upon the apparatus of Messrs. Young and Delcambre, just described. The latter merely composes, whereas Captain Rosenberg's machines both compose and distribute; and their setting-up process is much quicker than that of Messrs. Young and Delcambre—one being at the rate of 10,800, and the other of 6000 per hour.

" Fig. 3. *Captain Rosenberg's Composing Machine.*—*a*, the keys, on which the chief compositor performs, each key answering a particular letter, fixed above it, engraved upon a small ivory button. *b*, rack-frames, or a series of vertical rails, by which compartments are formed for letters, and into which they are lifted into the distributing machine. *c*, a receiver, to which all the types are conveyed, and in which the line is formed into words and sentences. *d*, a justifying-stick, into which each line, when complete, is removed from the receiver, *c*, for the purpose of being read over and justified by an assistant-compositor. *e*, a galley, into which the assistant-compositor causes each line to slide down from the justifying-stick, after it has been justified, for the purpose of being spaced out. *h*, a counting apparatus, by which the chief compositor is informed when each line is completed. This apparatus consists of a dial-plate and two hands. The plate is divided into inches and eighths of an inch. One of the hands is moveable, and must be placed at starting upon one of the marks, indicating the length of the lines, or width of the page to be composed. The other hand is so connected with the key movements, that it advances a distance equal to the thickness of each type composed; so that when it comes immediately above the other, that gives notice of the line being complete, when it is instantly removed by the compositor, and another begun. There is also a hammer, which strikes a small bell, as a warning to the compositor, a moment or two before each line is completed.

Fig. 3.

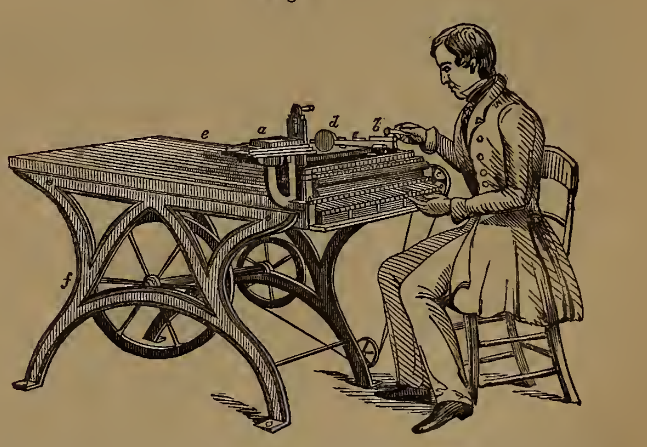


" The mode of working with the machine is as follows:—The chief compositor, who sits at the front of the machine, having his copy before him, performs upon the keys as he reads. By the action of the keys, the corresponding letters are forced out from their respective compartments, and are laid down upon an endless belt or chain, which is constantly passing through the middle of the machine from right to left. By the motion of this chain, the types, when liberated and placed upon it, are quickly conveyed into the receiver; where, by the action of a small eccentric, which is revolving at considerable speed, the types are deposited horizontally, one above the other, in the same order as the keys are performed upon; and are thus formed into lines, supported by a T-shaped slider, which is caused to recede in the same proportion as the types accumulate upon it. As each line is completed, (of which the compositor is informed by the dial and bell,) he turns with his left hand a small winch, (seen in the figure in front of the receiver *c*,) and thus lowers the completed line to the bottom of the receiver; while, by moving with his right hand a lever, (not seen in the figure,) the line is removed from the receiver into the justifying-stick *d*. The time consumed in this operation is less than a second. As soon as the line is thus removed, the assistant-compositor, (as shown in fig. 1, at the left end of the machine,) detaches, with his left hand, the upper end of that stick, (its lower end being moveable upon a fulcrum, as represented at *g*,) and having lowered it into a horizontal position, he reads the line, the types standing now in a *vertical* position. Having corrected such faults as may have occurred during the composition, he, by removing a slider, which constitutes the bottom of the justifying-stick, causes the line of type to drop down at once from that stick into a galley, *e*, where he spaces it out.

" The principal feature of *novelty* in this machine is, the endless chain on which the types are deposited, and by which they are conveyed into the receiver.

" Fig. 4.—The *Distributing Machine*—is quite detached from the other, and is worked independently of it.

Fig. 4.



" *a* is the galley, into which a portion of the page or column of type, after having been printed off, is transferred. *b*, a travelling-carriage, into which the lines are lowered from the galley *a*, line by line, by means of a slider with a handle on it, seen at the top of the galley. From this carriage, the different letters are distributed, by the action of the machinery, into separate receptacles provided for them. *c*, are keys, with the letters of the alphabet engraved upon them. *d*, a box, fixed to the end of the travelling-carriage, containing a convolute spring, by the effect of which the line of type in the carriage is continually pressed against the front of the carriage, until the last type in the line is delivered. *e*, grooves, made in an horizontal plate, into which the types are received, when distributed from the carriage *b*. In these grooves the types are formed into long lines, (one sort of letters in each line,) by the revolving motion of a small cam or eccentric working at the end of each groove."

We cannot afford to give further specimens, and the foregoing will suffice to show the quality of the work. If we were required to sum up our judgment in the fewest possible words, we should say that the work was very good, very useful, and very cheap. The frontispiece, illustrative of the character of the Artesian Well of Grenelle, is excellently executed, and the subject is, we think, judiciously selected.

ART. XVI.—MARVELS OF THE DAY.

CONTRIVANCE FOR EQUALIZING THE TRACTIVE FORCE ON ROADS AND ON RAILWAYS.

WHEN a carriage has to be moved along the whole length of a road or railway, the termini of which are upon the same level, the power properly expended is simply that requisite to overcome the friction and atmospheric resistance. Nevertheless, the quantity of power actually expended in practice, especially in the case of carriages moving upon common roads, is much greater than that due to these sources of expenditure. Every hill that is surmounted occasions an expenditure of power to balance the force of gravity; and although, in descending the hill, this power is again given out, yet it is not rendered available in practice to any beneficial purpose, but is rather a source of inconvenience which the drag has been invented to mitigate. Now there is nothing to prevent the surplus power which a carriage possesses in descending a hill, from being made available for assisting its ascent of the next hill it encounters; so as, in fact, to render the draught upon a hilly road just the same as if it were a level one. This may be accomplished by providing each carriage with a cylinder and air-vessel, so contrived that air will be forced into the air-vessel by the surplus power existing when going down hill; and the same air may, by its escape when the carriage is going up hill, be made to impart motion to the piston, and assist the ascent of the carriage. The mechanical arrangements requisite for such an apparatus are so simple and obvious, that it would be superfluous to describe them; but it may be desirable to ascertain the quantity of compressed air necessary to overcome different degrees of inclination.

Let w = weight of the carriage,
ϕ = angle of inclination of the plane.

Then the resistance arising from the weight alone = $w \sin \phi$, and the pressure of the carriage upon the surface of the plane = $w \cos \phi$: and since the friction is nearly proportional to the pressure, the resistance from friction alone = $a\,w \cos \phi$, and the whole force requisite to draw a carriage up an inclined plane,

$$a\,w \cos \phi + w \sin \phi \; \ldots\ldots \; (A)$$

when (a) is any constant.

To find how much compressed air, used expansively, is necessary to exert a given power,

Let x = elasticity of the air at any point of its expansion.

Then, if c is a constant quantity $\frac{c}{x}$ = volume of the air at the same point.

Let e = elasticity of the air when it begins to expand,
and p = power which it has exerted when its elasticity is equal to x.

Taking the pressure of the atmosphere at 15lbs., and supposing it to impede the expansion of the compressed air, then the power exerted by any indefinitely small amount of expansion is equal to $(x - 15)\, d\left(\frac{c}{x}\right) = -\frac{c\,dx}{x} + \frac{15\,c\,dx}{x^2}$

$$\text{Hence, } p = \int\left(-\frac{c\,dx}{x} + \frac{15\,c\,dx}{x^2}\right) = -c \text{ nep. log. } x - 15\frac{c}{x} + C$$

When $x = e$, $p = 0$; hence, to determine C, we get

$$-c \text{ nep. log. } e - 15\frac{c}{e} + C = 0 \quad \therefore C = c \text{ nep. log. } e - \frac{15\,c}{e}; \text{ also,}$$

$$p = c \text{ nep. log. } e + \frac{15\,c}{e} - e \text{ nep. log. } x - \frac{15\,c}{x}$$

$$\therefore c = \frac{p}{\text{nep. log. } e - \text{nep. log. } x + 15\left(\frac{1}{e} - \frac{1}{x}\right)}$$

and denoting by M the modulus of the common system of logarithms:—

$$c = \frac{p\,M}{\text{log. } c - \text{log. } x + 15\left(\frac{1}{e} - \frac{1}{x}\right).\ M} \; \ldots\ldots \; (B)$$

If the air be compressed to an elasticity of 150lbs. above the pressure of the atmosphere, and if it be allowed to escape when its elasticity is 3lbs. above that of the atmosphere, we have $e = 165$, and $x = 18$. M is equal to ·4343. By substituting these values in the formula, we get $c = {\cdot}6785 \times p$.

Suppose that the carriage requires to be moved over one mile, or 63,360 inches, then $p = 63360 \times$ resistance (found by formula A).

It is found by experiment, that a waggon of the best construction moving on a level railway, and weighing 24 cwt., requires a tractive force of 40lbs.; which gives us $a = \frac{40}{24 \times 112} = {\cdot}0149$ and $w = 2688$. By substituting these values in formula (A), we find the resistance opposed by the carriage in ascending planes of any inclination; and the bulk of compressed air requisite to move the carriage one mile up any inclined plane will then be found by the following formula:—

Bulk of compressed air in cubic inches,

$$= \frac{c}{e} = \frac{{\cdot}6785 \times 63360 \times \text{resistance}}{165} = 260{\cdot}54 \times \text{resistance}.$$

TABLE showing the quantity of compressed air requisite for propelling a carriage weighing 24 cwt. up one mile of a railway inclined plane, at different degrees of inclination.

Inclination of the plane in degrees.	Force required to draw the carriage up the plane in lbs.	Quantity of compressed air requisite to propel the carriage one mile along the plane in cubic feet.	Differences between the forces required to propel the carriage on the plane and on a level.
0°	40	6.028	0
2°	134.72	20.05	14.12
4°	227.34	34.1	28.07
6°	320.82	48.12	42.09
8°	429.36	64.4	58.37
10°	506.19	75.93	69.9
12°	598.08	89.71	82.68
14°	689.21	103.38	97.35

It is of course obvious, that, by substituting the tractive force on a level road for that on a level railway, results answerable to common roads locomotion will be obtained.

Chronological Chart of British Architecture.—This is a chart about to be published by Mr. Varty, illustrative of the mutations in Gothic Architecture from the twelfth century, down to the period of its corruption in the reign of Elizabeth. It shows also, the genealogy and armorial bearings of the sovereigns of England, from the era of the Heptarchy down to the present time, together with the more important events of British and General History.

The various views of architectural constructions are admirably executed, and the chart is accompanied with a volume of letter press, which manifests much literary ability, and an intimate acquaintance with the subject.

Whitworth's Street Sweeping Machine.—This machine consists of a cart, the bottom of which is very near the ground, and behind which is an axle studded with brooms, and put into revolution by the wheels of the cart. As the cart is drawn on, the cylinder of brooms sweeps the mud up an inclined shoot, at the extremity of which it falls into the cart. On a very muddy road, the cart is said to become full of mud in six minutes.

SCREW STEAM VESSELS.

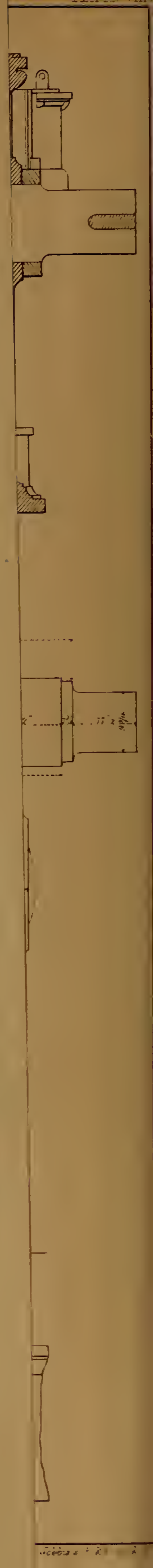
The Novelty.—This is a screw vessel, built of iron, and in which the steam is completely reduced to the condition of an auxiliary power. The builder of this vessel is Mr. Wimshurst, who also, we believe, claims much of the merit of the screw application.

The *Novelty* is a very burthensome vessel, built with the view of testing the applicability of steam in combination with a screw, as an auxiliary power to merchant ships. She is three-masted, with a capacious hold; and as her funnel forms the mizen-mast, and as she is, of course, without paddle-boxes, she differs in no respect, in external appearance, from an ordinary sailing vessel.

The *Novelty* is fitted with a pair of non-condensing engines; the cylinders are 13 inches diameter, and the length of the stroke 2 feet 4 inches; the effective force of the steam on the piston is said to be about 20lbs. mean pressure; but we suspect it is in reality much more. The engines make about fifty-five double strokes per minute, and the power is applied direct to the crank on the screw-axis, without the intervention of gearing, or any kind of multiplying apparatus.

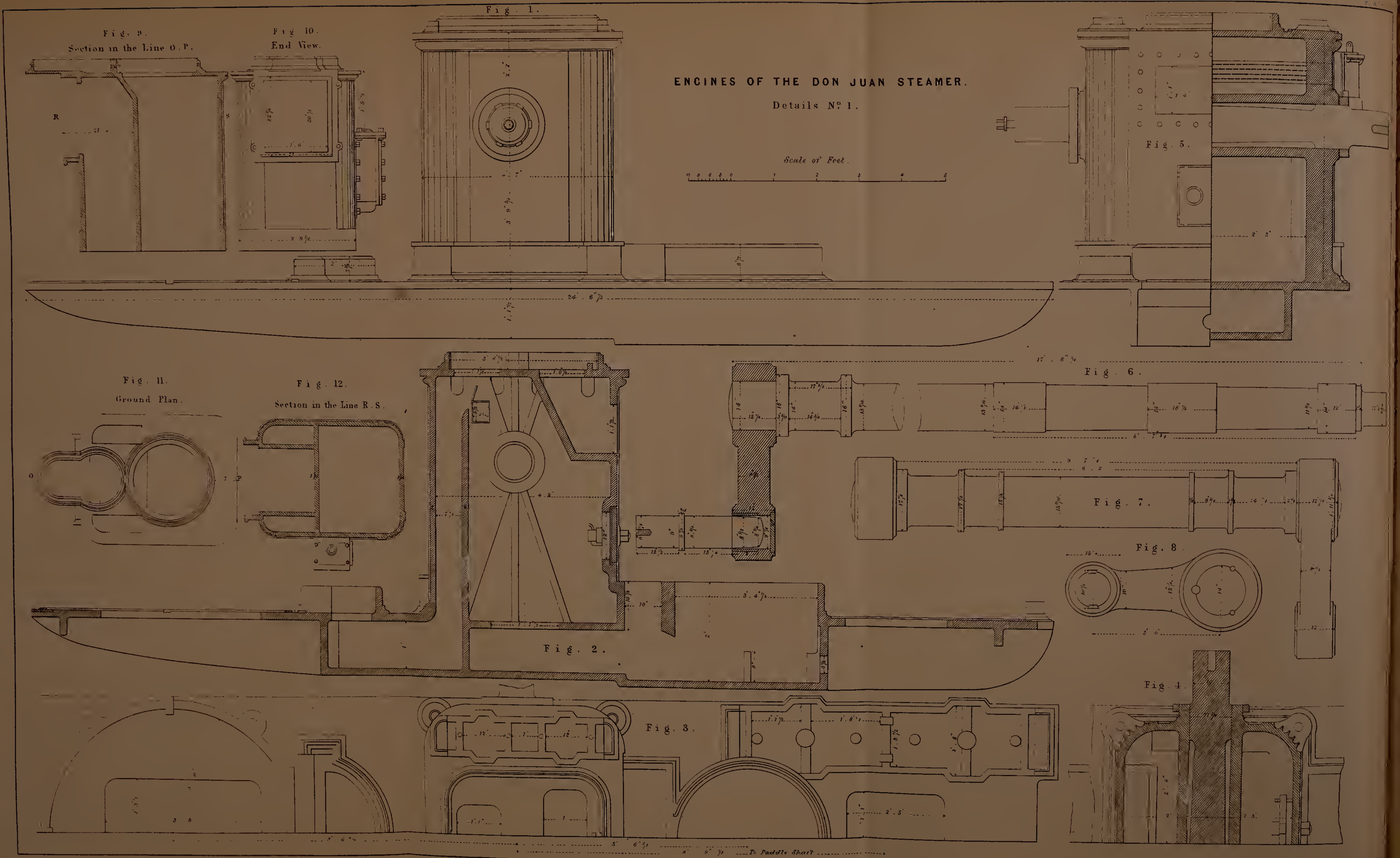
The tonnage of the *Novelty* is 328; and, with 140 tons of ballast on board, her immerged sectional area is 164 feet. Mr. Wimshurst, the builder and proprietor of the vessel, says that her power is only 25 horses, and her speed 8½ statute miles; but of the correctness of both of these statements we have serious doubts. We do not find that the *actual* power of the engines has been ascertained by any competent method; and the speed alleged to have been attained requires authentication. Such rude and general statements as Mr. Wimshurst furnishes carry with them no conviction, and are not suitable for our pages.

Great Northern.—We are happy to learn that the proprietors of this vessel are about to remove those parts of the machinery which, in our last Number, we pointed out as being incurably defective, preparatory to the introduction of new machinery upon a better plan. If, as we believe to be the fact, our strictures have brought about this salutary change, the proprietors of the vessel have reason to thank us for our severities. A long time might have elapsed before they heard the truth from any other quarter. We shall again visit the vessel, as soon as the proposed improvements have been carried into effect; and if the engines then deserve praise, they shall have it.



ENGINES OF THE DON JUAN STEAMER.

Details Nº 1.



THE ARTIZAN.

No. III.—MARCH 31st, 1843.

Art. I.—THE ASSOCIATION OF THE PROPRIETORS OF STEAM SHIPPING.

The design of this Association is undoubtedly an excellent one; and its past operations have, we believe, been attended with some success: yet, although several years have now elapsed since its formation, no *important* service to steam enterprise has yet been achieved by its instrumentality; and the conviction, we fear, is an extending one, that its energies are neither very active, nor directed to very profitable objects. It is undeniable, indeed, that some benefit has been realized by this confederation; but the amount is generally considered to be marvellously small, and certainly very poorly fulfils the high expectation which naturally grew out of such an establishment. The fact is, the Association has wasted its strength on trifles, whilst objects of important attainment have been comparatively neglected, and has magnified trivial successes into great events, with the view of concealing the insignificance of its achievements.

The effect of these misdeeds has been, to breed a serious disaffection among the supporters of the project; and this unfavourable symptom has been aggravated by an impression which appears latterly to have gained ground, that the Association is too much under the sway of a particular clique, and too much the instrument of its interests and ambition. In this accusation there is, we have no doubt, much injustice; yet the belief is both very general and very inveterate; and a deep, though unapparent discontent has sprung out of the conviction, which is shedding a blight over every transaction of the Society, and, like a mephitic vapour, poisons the very springs of life, while its existence is all the time unsuspected. Against an influence so subtle, and at the same time so irresistible, it would be something more foolish than folly to contend; and, to our apprehension, nothing can be plainer, than that this Association must speedily expire if it do not so bestir itself as to do something worthy of its means and influence, and answerable to its exalted pretensions. Some of the parties who were lately active in its behalf have already withdrawn their support, and the defection will, we fear, proceed with an accelerating rapidity, unless the work of regeneration be immediately begun. It is our intention, on the present occasion, to indicate a few of the improvements which the Association ought, in our opinion, first to carry out, and which are all within its power to accomplish; and the danger and urgency of the crisis leads us to hope that our suggestions may not be received with contempt, in spite even of the insignificance of the organ from whence it is their destiny to emanate.

Before proceeding to descant, however, upon the virtues of our prescription, it is necessary that we should give our readers some idea of the nature and objects of this Association, of which many of them have probably never before heard. This end will perhaps be best effected by a few extracts from "The Rules and Regulations" under which the Association is governed, and which very clearly declare its views and purposes; and by recounting what has been done, we shall best ascertain what has not been done, as well as much of what has not been attempted. The Association was founded in 1840: from its circular of that year we make the following quotations:—

"I. That the Association be called, The General Association of Proprietors of Steam Shipping, and do consist of owners of steamers under the British flag, who shall contribute to the funds of the Association, and shall consent to these Rules and Regulations.

"II. That the objects of the Association shall be—the protection and advancement of the common interests of proprietors of steam shipping; the amelioration of legislative enactments interfering prejudicially with steam navigation; the constant and efficient supervision of legislative proceedings, whether applying to local or general objects, wherein any principle affecting generally the fair rights of steam-ship owners may be involved; the especial consideration of all questions, public or individual, directly or indirectly connected with the steam marine; the instant communication with members of the Government and the Houses of Parliament upon all matters connected with this branch of property involving immediate consideration; and, generally, the redress of all grievances, the removal of all unjust burthens and restrictions, and the attainment of beneficial objects which may affect the general or particular interests of owners of steamers contributing to the Association, where such designs can be promoted more effectually by an associated body than by individual exertion; the Association, in objects of general interest, undertaking the conduct of such proceedings as may be necessary; but, in local and particular questions, confining its operations, as a general rule, to acting in aid of the parties immediately affected."

All this is, we think, very wisely conceived, and very well expressed; and certainly no one can complain that the field of exertion the Association has marked out for itself is not sufficiently extended. The funds are provided as indicated in the following resolution:—

"III. That the Association shall be supported by a *pro ratâ* contribution of (and in no case to exceed) 6*d*. per ton per annum upon the registered tonnage of the steamers belonging to the company or individual that may join the Association; and further, in no case shall any single contribution exceed £100 a-year."

The companies which have maintained their adhesion to the Association, are the following:—The Aberdeen Steam Navigation Company; The Alloa, Stirling, and Kincardine Steam Navigation Company; The Bristol Steam Navigation Company; The British and Irish Steam Navigation Company; The Dover and Boulogne Steam Packet Company; The City of Dublin Steam Navigation Company; The Commercial Steam Packet Company; The Dublin and Glasgow Steam Shipping Company; The Dundalk Steam Packet Company; The General Steam Navigation Company; The Herne Bay Steam Packet Company; The Hull and Hambro' Steam Packet Company; The Hull Steam Packet Company; The Hull and Leith Steam Packet Company; The Isle of Wight Steam Packet Company; The Leith and Clyde Steam Navigation Company; The London, Leith, Edinburgh, and Glasgow Steam Packet Company; The Margate and London New Steam Packet Company; The Peninsular and Oriental Steam Navigation Company; The St. George Steam Packet Company; The South of England Steam Navigation Company; The Waterford Steam Navigation Company; and the Waterman Steam Packet Company.

The committee of management is composed of a chairman and fourteen members; of whom one half are nominated as representatives of companies, and the other half elected by the subscribers at a general meeting. The following gentlemen are the present members of the committee representing companies:—Charles Bleaden, Sir John Campbell, Capt. Rivett Carnac, George Lunell, Robert Matthew, Joseph Pim, and C. W. Williams; and the following are members by election:—Joseph Adams, Arthur Anderson, Francis Carleton, J. G. Doran, James Hartley, and A. G. Robinson. The vacancy occasioned by the secession of Mr. Hore has not, we believe, been yet filled up. The secretary is Mr. Arthur Davis, by whom the meetings are convened, and the general business of the Association transacted, under the direction of the committee.

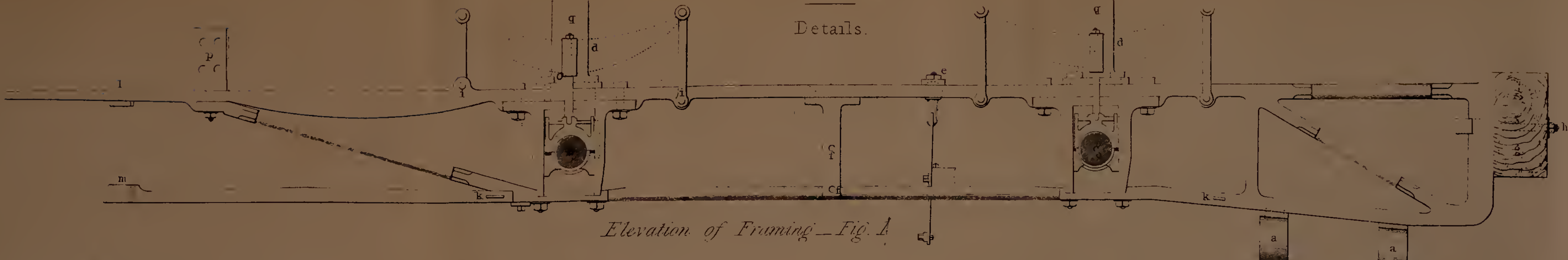
Such, then, are the objects and constitution of this Association; and, upon the whole, we think very favourably of them. Nevertheless, it appears to us that too prominent a position is given to that kind of amelioration which is to be achieved by Act of Parliament, and which, after all, is the least important of any. It is very little that Parliament can do for the owners of steamers, in comparison with what they can do for themselves; and we do think that it has been the fault of this Association all along to rely too much upon this feeble and untractable assistant. Not that we for a moment contend that every instalment of advantage, however insignificant, should not be accepted; but that we deem it unadvisable that the energies of the Association should be wasted on a barren soil, while the more promising fields of exertion have received no cultivation. During the past year, the achievements of the Association have consisted in obtaining a reduction of the duty on coals consumed by British steamers abroad, from 4*s*. to 2*s*. per ton, and in defeating a clause in the Blackwall Railway Bill, which stipulated that steamers should not navigate the Pool; and although these are, no doubt, very useful services, it is, we think, not quite so clear that they might not have been accomplished without any Association at all, by the mere intervention of a Parliamentary agent. In short, it appears to us to be little better than a burlesque upon boards of direction, with their chairmen and secretaries, and council-halls, to resort to their ponderous machinery for an end so disproportionate: it is like creating a whirlwind to give motion to a feather, or building a mill to grind a bushel of malt.

The evils, to the alleviation of which the attention of the Association is now directed, are, we understand, 1st, The high rate of dues paid by foreign-bound steamers in passing Dover harbour; 2nd, The operation of the law of deodands under coroners' inquests; and, 3rd, The claims of France to decide questions of damage occurring to French by British shipping at sea. These evils are, we suppose, to form the staple agitation of the ensuing year; and, supposing that they were all to be carried into effect to-morrow, in the manner the Association wishes, what is the amount of benefit to the steam shipping interests of these islands which could result from the attainment? Would shares acquire a penny in the pound more of dividend, or

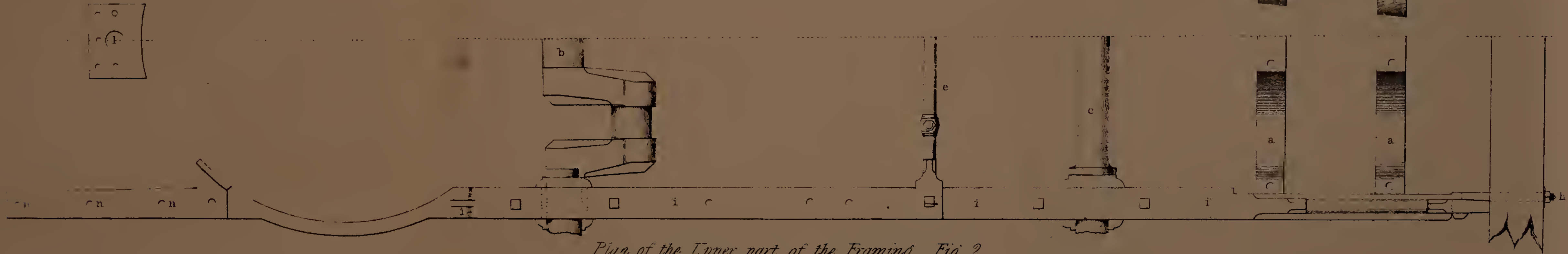
LOCOMOTIVE ENGINE ON THE LONDON AND BIRMINGHAM RAILWAY

EDWARD BURY.

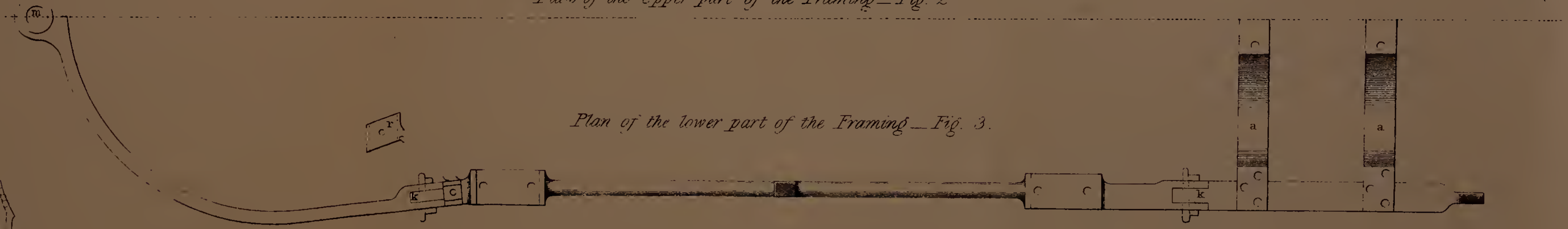
Details.



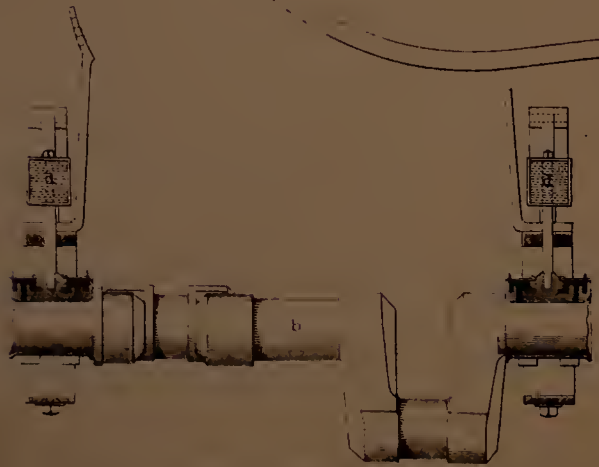
Elevation of Framing _ Fig. 1.



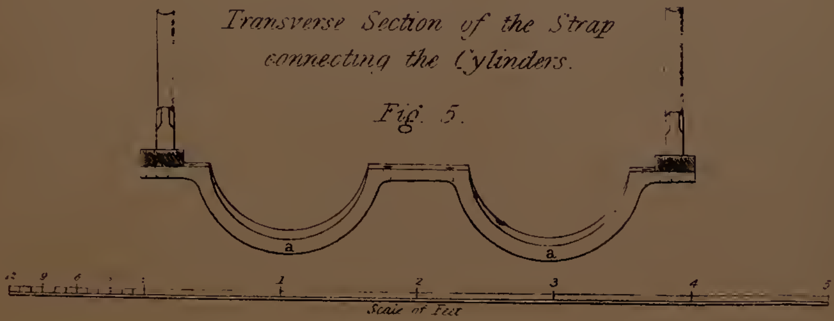
Plan of the Upper part of the Framing _ Fig. 2.



Plan of the lower part of the Framing _ Fig. 3.

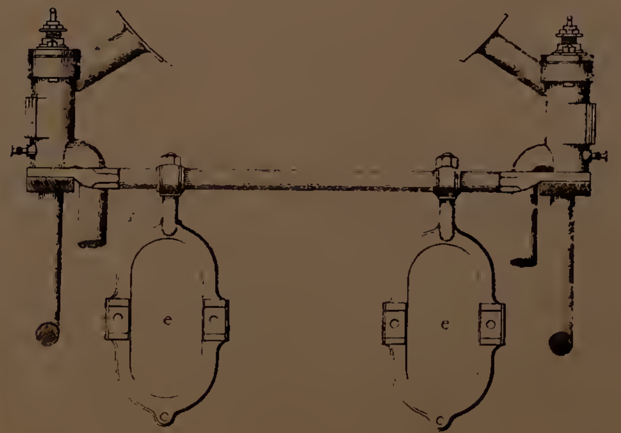


Section through the Frame showing the Crank Axle. Fig. 4.



Transverse Section of the Strap connecting the Cylinders.

Fig. 5.



Section through the Frame showing the Force Pump.

rise a thousandth part in their total value? The only party we can see which would be in any way benefited by the projected improvements, is the General Steam Navigation Company; and is it reasonable that, for a trivial benefit to one particular company, the rest of the companies in the country should be encumbered with an expensive and unnecessary machinery? Abuses such as this will, if not remedied, inevitably bring about a universal defection; and the Association will become extinct, not because such a confederacy is superfluous, but because it has distended trifles to a ridiculous importance, while neglecting the more serious portion of its functions.

It is right, however, that the Association's exertions in aid of the reduction of light dues should receive the praise to which they are entitled; but all such elements of amelioration are as nothing in comparison to the benefit to be derived by bringing about a reduction in the consumption of fuel in steam vessels by registering the work done in relation to the fuel consumed. Every one knows what an extraordinary increase has been achieved in the economy of the Cornish engines by this simple expedient. In Cornwall, the quantity of work done and of fuel consumed by each engine is periodically ascertained and published; and the effect of the measure has been, to excite such emulation among engineers, and induce so scrupulous an attention to a host of minutiæ, each trivial in itself, but important when combined, that the efficacy of the fuel has, in the lapse of a few years, been increased more than *four-fold;* in other words, about three-fourths of the fuel requisite a few years ago is now saved. We do not anticipate that an equal reduction would be effected in steam vessels by the same expedient; yet we think the saving would be so great as to brighten the prospects of steam enterprise, and bring about, in the course of a few years, an amount of advantage such as this Association might vainly attempt to realize by any other agency.

There is one difficulty which stands in the way of the adoption of this plan, and that is, the want of some simple and efficient instrument which will observe and register the quantity of work done by a marine engine under every vicissitude of speed and pressure, and to which the Cornish counter would not apply. Professor Moseley has invented an instrument for this purpose, which he calls a "constant indicator;" but we think it too complicated and expensive for common use, and believe that a better may be devised. We shall probably next month describe an instrument of this description, such as appears to us well adapted to the intended purpose.

Concurrently with these innovations, some steps should, we think, be taken to secure a constant supply of eligible persons as engineers of steam vessels, so that, as often as a vacancy occurs, it may be filled by a person whose capacities have been previously tested, and who may in every way be relied upon. It appears to us that all the engineers of our larger steamers, hereafter appointed, should undergo an examination touching their skill;—not that any conceivable examination can, *per se*, be a sufficient criterion of eligibility, but that this test should not be neglected in conjunction with other modes of arriving at a right conclusion. It may be doubted, indeed, whether mechanics would be willing to submit to such an ordeal; but we are very confident that the better class of them would be very glad to see it established; and it is well known that at Woolwich something of the kind has been long in force, and does not deter men from entering the Government employment, though accompanied by other obnoxious conditions. At the same time, we think that any species of examination which would erect scientific attainments into a test of eligibility, would be worse than useless, and should on every account be avoided. We shall shortly have a fitter pretext for saying something on this subject, and will now only make the very commonplace observation, that the greatest scientific proficient in the world may make a very bad engineer of a steamer, while a person who is both unscientific and illiterate may make a most excellent one.

These, then, are the chief ingredients of our nostrum for restoring steam enterprise to health and vigour. The Association, by becoming the instrument of such great good, could not but be zealously supported by steam-ship owners; and although the expense of the Association's operations would certainly be somewhat greater, the benefit would be in a far greater proportion. It would be necessary that every vessel should be fitted with an instrument, at the vessel's own expense, for ascertaining the quantity of work done; and the coal account of that vessel would give the amount of fuel consumed. The indications of the several instruments would be noted once a month by a person appointed by the Association for that purpose; and the quantity of work done and of fuel consumed by each vessel—in other words, the efficiency of her engines—should be published monthly:—any residue of coal in the coal-boxes at the end of that time being weighed or measured, so as to establish a true result.

ART. II.—SANITARY ARRANGEMENTS IN LARGE TOWNS.

1. *Report from the Poor Law Commissioners on an Inquiry into the Sanitary Condition of the Labouring Population of Great Britain.* 3 vols. folio. 1842.
2. *Two Lectures on the Defective Arrangements in large Towns to secure the Health and Comfort of their Inhabitants: read before the Hull Literary and Philosophical Society.* By HUMPHREY SANDWITH, M.D. London: Simpkin, Marshall, and Co. 1843. 8vo. pp. 55.
3. *The Quarterly Review, No.* 142.

THE sanitary condition of the people is at length receiving some of the attention due to a subject of such moment, and so imperatively demanding amelioration. The Report, which stands first in our list, reveals an intensity of wretchedness among our industrious classes unparalleled, we believe, in any age or country, and constitutes a deplorable illustration of the iniquity of that legislation which has filled the poor man's cup with bitterness. Important as were the benefits conferred by the late Government upon the operative classes, it has wiped out the recollection of them all by its cruelty to the helpless and destitute, and has left on the tablet of men's memories a searing and abiding hatred, which years will be required to exterminate. The poor have always the poor man's sympathies; and any oppression exercised on the destitute will be resented by those who are not destitute, though, perhaps, but a degree removed therefrom; and these persons have generally the means of making their animosity felt. This the late Administration learned in their expulsion from office; and that event carries a lesson to future governments, which ought not to be thrown away, that, of all experiments, the most impolitic, as well as the most unholy, is the oppression of the poor.

In all our large towns, the habitations of the poorest classes are inconceivably wretched, and are ever active hot-beds of disease. It is an extraordinary fact, too, that, however wretched those habitations may be, they invariably meet with tenants; so that the poor appear almost to be without the option of avoiding the worst dens which may be provided for their reception. In these abodes of misery, vice, sedition, and disease form a fearful and never-failing alliance; and the pestilence spreads over the land, from each of these centres, in the most diverse and Protean forms of mischief. It is in the discomforts of the social condition that political animosities acquire much of their malignity; and all other remedies for quenching the turbulence and disaffection of the populace must be ineffectual, so long as the grand cause of all the discontent remains in undiminished activity. It is therefore, in every way, the part of a wise legislation to give some attention to the domestic comforts of the working classes; and we are thoroughly convinced that a regard to such means of improvement will be far more effectual than those coarser and more obvious expedients which are now resorted to in assuaging political discontent, and stilling political commotion. It is by the social miseries of our artizans that the flame of political excitement is fed; and every alleviation of these miseries must contribute to draw off in silence a portion of that political electricity which will else accumulate and gather strength until it descends upon the earth in thunder. Viewed, therefore, merely in the light of a political expediency, the work of ameliorating the condition of the working classes stands recommended by considerations of no trivial importance; and of this work of amelioration, the improvement of the dwellings of the poor, by adequate sanitary provisions, constitutes a very important part. There are other considerations, however, still more important. All removable causes of disease contribute to the impoverishment of the state, both by encumbering it with a legion of debilitated paupers, and robbing it of a deal of valuable labour. If, for example, the defective sanitary provisions of any particular district breed a malignant fever, which sweeps off a number of artizans, a large amount of skill is lost to the state, and the wives and children of the persons deceased become public burdens. It may, indeed, be contended that the wives and children stand the same chance of being carried off as the heads of families, and that the same proportion of each would die. But, admitting this to be correct, it does not follow that it should be the wives and children of the deceased persons who should die; and those of them who survived would still be national burdens. It is very well established, moreover, that the ravages of any epidemic disease produce only a very temporary effect upon the volume of population; so that, taking the average of a few years before and after the havoc of a pestilence, the number of the people appears to be just the same as if no such mortality had arisen. But the average age of the population cannot be the same; so that the effect of the ravages of a malignant fever in a particular district is not to diminish the number of its inhabitants, but to deprive it of a large proportion of those whose industry and skill constitute the wealth of the nation. As deaths become more numerous, births become more numerous in nearly the same proportion; and the only effect of excessive mortality is to supplant a staid, skilful, and slowly-increasing population by one that is volatile, inexperienced, and which increases rapidly. The disadvantage of such an exchange is sufficiently obvious; and one of its most hurtful consequences is, to give the young and visionary such a preponderance in numbers among the working classes, as to make that great section of the community, upon the whole, both very fiery and very fickle, and to be perpetually betraying combinations of artizans into violent and illegitimate courses. The mobs of our large towns have always been found to consist, for the most part, of mere boys; and the return of the ages of the prisoners tried by the Special Commission for the late riots in our manufacturing districts, shows that most of the *leaders* of that movement were mere striplings. While there were 316 between the ages of 16 and 26, there were only 18 between the ages of 46 and 56; and, between 56 and 66, only 5. It would appear, therefore, that the unhealthiness of the poorer districts of our large towns not merely impoverishes the country by burdening it with a host of dejected paupers, and abstracting a large amount of skill and labour from the commonwealth, but keeps the public peace in perpetual peril, by the preponderance thus given to combustible minds. And if the arithmetic of these evils be taken, it will, we believe, be found that their toleration is infinitely more expensive to the country than would be the application of a costly and effectual remedy.

We have been induced to take this mercenary view of the question, not because we think it the view which should be taken, but because we fear it is the only one likely to be materially operative with those who have the means of improvement in their hand. Nevertheless, we protest *in toto* against the doctrine that our working men are to be regarded as mere instruments of production, or are to be weighed in the same scale of statistics as a steam-engine or power-loom. Supposing that no advantage to the state were to follow the amelioration of the working man's condition, is that holy task, therefore, to remain unattempted? If property has its rights, has it not also its duties, and is it not one of the most necessary, as well as most sacred, to at least make every endeavour to assuage the miseries of the industrious poor? The whole security of property rests on the toleration of the majority of the people; and that toleration will assuredly be brought to a close if discontent acquire the breadth and vehemence due to a protracted and unrelenting oppression. An evil such as this is one which will inevitably work its own reparation as soon as endurance becomes exhausted, and the measure of iniquity is full; and justice and order will, of necessity, be involved in one common ruin with the guilt which kindles the conflagration.

We have left ourselves but little room to say much of the particular sanitary arrangements which our large towns most imperatively require. They chiefly, however, resolve themselves into, 1st, The provision of an improved class of dwellings, and the demolition of every tenement which cannot be made habitable with comfort; 2nd, an improved sewerage; and, 3rd, a more plentiful supply of better water. We have already seen, that, however bad dwellings may be, they will be sure to obtain tenants; and therefore, the only effectual mode of extirpating those diseases and discomforts which arise from crowded, rickety, and ill-ventilated habitations, is, either by insisting upon such repairs as will make them tenantable with comfort, or else by condemning them altogether. These are things which should not be left to landlords, who, in the case of the poorest class of dwellings, will scarcely ever be at the expense of repairs, however necessary: and as the tenants are, for the most part, a few weeks in arrear of rent, they are almost, if not altogether, at the landlords' mercy. Then, as regards sewerage, most of our provincial towns are shamefully defective; and even London is far from being complete. As respects water, we do not believe that there is a town in the kingdom adequately supplied; and many of the imperfections of the sewers arise from an insufficient run of water through them. To mitigate this evil, a sluice, or species of movable dam, has been introduced in many sewers, which retains the water above it, and which, on being opened suddenly, scours away the deposit. This operation is technically termed "flushing;" and the apparatus in use in the Holborn and Finsbury division of metropolitan sewers for this purpose, is ingenious, and, we understand, effectual. But the true remedy is to be found in a more abundant supply of water, which is necessary, in any case, for the more effectual purification of courts, alleys, and passages, as well as for the better supply of houses. So essential is a good sewerage to the public health, that, in St. Bartholomew's Hospital, a strict relation has been found to obtain between the goodness of the sewerage and the proportion of the fever patients; and the experienced physicians of that establishment are able to point out on the map, with extraordinary truth, the relative efficiency of the sewerage of each particular district of London, by the number of fever patients it furnishes.

But the London water is not merely deficient in quantity, but in quality is execrably bad; and its badness is increased by the plan of storing in cisterns or casks, on certain days, a sufficiency for the week's supply. These receptacles, unless frequently cleansed, get very foul, and make the quality of the water much worse than before: and this necessary operation of cleansing is almost sure to be neglected in houses inhabited by a number of persons, among whom a contest arises as to the party on whom the cleansing should devolve; or in houses, the tenants of which are so often changing, that they are indisposed to take that trouble for so brief a benefit. Besides, many houses are inhabited by aged and very poor persons, who can neither accomplish this operation themselves, nor afford to pay for getting it done. The smoke nuisance is another serious enemy to the health and comfort of the inhabitants of large towns. We hope to see it speedily done away; and this end may, we think, be at once accomplished by a few uncompromising convictions. If people cannot otherwise avoid the production of smoke to defile the atmosphere, let them use a mixture of coke and anthracite in their furnaces, as has already been done in many cases with perfect success. Interments within the precincts of towns, too, should, we think, be abolished by law; for, unless the practice be made penal, it will never be relinquished. We think, also, that every town and village should be provided with a public park, and with bathing places, which might be always accessible without any expense. We should be glad, moreover, to see athletic sports in more general favour. Painters and sculptors complain of the deterioration of the human form since the time of the ancients; and the fault, we believe, altogether arises from the general absence of robust exercises among the present generation. In fact, the great majority of our young men of the present day are either very sanctified, very dissolute, or very pedantic; and each of these characteristics is supposed to be inconsistent with those athletic recreations which are necessary to give a due developement to the physical and intellectual energies.

We cannot afford to extend these observations farther, and must here close them, although there are a vast number of points upon which we meant to have said something that we have not been able to touch. To us the conviction is ever present, that the safety of the state lies in the improvement of the people; and that, to achieve this improvement, agencies which act upon the body, as well as those which affect the mind and conscience, must be put into operation. Of the first class of agencies, effectual sanitary laws are among the most important; and, conjoined with the other aids to health we have indicated, could not fail, we think, if well devised and administered, to be productive of the most salutary effects. A *Board of Health* has long existed in France, and has conferred the greatest benefits upon that nation; but the attempt to form a similar board in this country, though often made, has been always unsuccessful. It has been proposed to engraft the functions of such a board upon the Poor-law Commission; adding, for this purpose, two new officers to each district, viz., a Physician and an Engineer. The name of the Poor-law Commission is, we confess, hateful to us, from the cruelties inflicted, through its instrumentality, upon the poor in every part of the country; yet the fault, after all, may rest chiefly with the makers of the law, and not much with the persons appointed to carry out its provisions. Upon this point we do not feel ourselves qualified to offer any opinion; but, whatever conclusion may be come to respecting the machinery to be adopted, we are quite clear that the sanitary measures to which we have adverted ought not to be delayed. If it be the property of impurity to engender disease—of disease to destroy the equilibrium of the most numerous class of society, by removing the discreet and skilful, and forcing up in their stead a crop of incandescent simpletons, the country must be always kept on the brink of rebellion, which only awaits some such agency as wide-spread distress or political agitation to apply the lighted brand; and deplorable as the explosion must be, and terrible the vengeance, they can only be looked upon as a just punishment of that apathy and corruption which mocked at the sleeping volcano.

ART. III.—TABLE OF DIMENSIONS AND COST OF RAILWAY BRIDGES.

(Liverpool and Manchester Railway.)

THE following table contains, in a very condensed form, all the more important particulars respecting the bridges on the Liverpool and Manchester Railway, and, upon the whole, gives a correct idea of the present cost of similar works. From this allegation, however, we must except the case of the Rainhill skew bridge, the cost of which, it will be observed, is much greater than that for which such works can now be executed. This is chiefly owing to the inexperience of our mechanics in erecting skew bridges at that time, and the consequent difficulties experienced. Indeed, ten or twelve years ago, skew bridges were almost unknown, and their construction presented difficulties almost insuperable to ordinary artificers.

We are not certain that this table, or some part of it, has not been already published; yet we have not been able to find any part of it in any of the well-known treatises on railways. We have caused inquiry to be made, moreover, of the principal publishers of mechanical works, and they all say that the table is new to them. Under these circumstances we have given it a place in our pages; which, had it been published, to our knowledge, in any other work previously, we should not have done.

Whilst on the subject of railway bridges, we may take occasion to remark, that, in cases where the span is great, and the bridge is very skew, beams of cast-iron, trussed with malleable iron bars, appear to us to form the best description of support for the roadway which can be used. This is the description of bridge employed to carry the Blackwall Railway over the Minories; and no bridge can better fulfil its purpose. In the case of crossing over streets, moreover, it is important to have as little interception as possible, whether of view or carriage-way; and the species of bridge formed upon beams affords less obstruction than any description of arch bridge can possibly do.

The bridge which carries the Blackwall Railway over the Commercial-road is a very elegant variety of the beam bridge. As the span is too great to be compassed advantageously by a single beam in length, the total length is broken into three portions—the intermediate beams, and inner ends of the two outside beams, beine supported by granite pillars erected in the roadway for that purpose. This plan, indeed, is now common on many railways; and in certain situations it is, we think, the best plan which can be adopted.

In reference to this Table of Bridges, we have only room to add, that any merit involved in its compilation is due to Mr. Booth, the secretary of the Liverpool and Manchester Railway Company.

The table explains itself so fully, that it is unnecessary to trouble our readers with any remarks of ours in illustration of the mode of finding any particular information in it. We must observe, however, that some little uncertainty attaches to the cost of the bridges at Old Lane, Rathbone's Lane, Hodgkinson's Cattle, Stothard's Occupation, and Jones's Nos. 2 and 3. The table, indeed, was compiled before those bridges were altogether completed; but the amount given is that of the contract, and is, therefore, a very near approximation. Nevertheless, it is of course preferable, where it can be done, to give the cost as ascertained after the construction has been completed, as there are frequently extras which go to swell the total sum. There is no railway, however, upon which bridges may not, from time to time, require to be constructed; and most large ones have some such work constantly going on; so that it is impossible, in such cases, to get the cost, as completed, of all the bridges of the line. The table we have given, however, is, we believe, upon the whole, very complete: it gives a popular view of the kind of structures which may be expected to occur in similar undertakings, and embodies statistics which we think will be acceptable to most persons interested in railways, whether in this or other countries.

	Names of Bridges, commencing at Liverpool End.	Number of Arches.	Askew or Square.	Railway under or over Road.	Span of Arch in Feet on Skew Face.	Whcther Ashler, Rubble, or Brick-work.	Description of String Course Coping.	Abutments.	Width of Way in Feet between Parapets over Arch.	Width of Way in Feet between Side-walls under Arch.	Height under centre of Arch from Railway or Road.	Slope of Common Road over Railway.	Slope of common Road under Railway.	Number of Feet common Road is raised.	Number of Feet common Road is sunk.	CCST.	
																£	s.
1	Park's Bridge	1	square	under	..	Ashler, with brick arch faced with stone	Stone	Masonry	28.0	30.0	26.9	Level	..	..	..	741	5
2	Old Lane Bridge	,,	,,	,,	..	Brick-work	,,	Brick	12.0	30.0	18.0	,,	..	..	..	156	10
3	Wright's Bridge	,,	,,	,,	..	Ditto	,,	,,	15.0	30.0	18.0	,,	..	..	..	184	5
4	Rathbone's Lane Bridge	,,	askew	,,	38.0	Ashler, with brick arch faced with stone	,,	Masonry	23.6	30.0	24.3	,,	..	..	..	973	14
5	Sandown Bridge	,,	square	,,	..	Ashler	,,	,,	15.8	40.0	40.6	,,	..	..	..	765	13
6	Mill Lane Archway	,,	askew	,,	25.6	Brick-work	None	Rock	60.0	25.0	35.0	,,	..	..	..	91	3
7	Wavertree Nook Bridge	,,	,,	,,	38.0	Ashler	Stone	,,	20.0	37.6	18.0	1 in 20	..	3.0	..	274	9
8	Ainsworth Bridge	,,	square	over	..	Ditto	,,	Masonry	34.0	12.0	13.6	..	Level	..	..	418	5
9	Case's Bridge, No. 1.	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	16.0	..	,,	..	..	418	0
10	Ditto ditto, No. 2.	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	16.0	..	,,	..	..	493	0
11	Childwall Lane Bridge	,,	,,	,,	..	Brick arch and ashler quoins	,,	,,	66.6	14.0	16.0	..	,,	..	..	346	12
12	Pilch Lane Bridge	,,	,,	,,	..	Ditto	,,	,,	34.6	16.0	16.0	..	1 in 30	..	5.6	270	1
13	Jamieson's Bridge	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	18.0	..	Level	..	..	202	7
14	Lord Derby's Bridge	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	20.0	..	,,	..	..	241	16
15	Baron's Bridge	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	16.0	..	,,	..	..	240	9
16	Ball's Bridge	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	19.0	..	,;	..	..	204	5
17	Huyton Hey Bridge	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	12.4	..	,,	..	..	302	3
18	Peel's Bridge	,,	,,	,,	..	Rubble, with ashler quoins	,,	,,	34.6	12.0	14.0	..	1 in 30	..	1.6	215	0
19	Lee's Bridge, No. 2.	,,	,,	,,	..	Brick arch and ashler quoins	,,	,,	34.6	12.0	14.10	..	Level	..	..	215	8
20	Ditto ditto, No. 1.	,,	,,	,,	..	Ditto	,,	,,	34.6	12.0	21.10	..	,,	..	..	282	0
21	Whiston Bridge, No. 1.	,,	,,	under	..	Ditto	,,	,,	47.6	22.0	18.0	1 in 13	..	14.0	..	960	5
22	Ditto ditto, No. 2.	,,	askew	,,	47.0	Ashler, with brick arch faced with stone	,,	,,	24.0	30.0	18.0	1 in 20	...	15.0	..	174	0
23	Makin's Occupation Bridge	,,	unfinished	..	..	Timber, on stone piers	..	..	..	30.0	..	..	..	..	..	74	15
24	Cumber Lane Bridge	,,	square	nnder	..	Ashler	Stone	Masonry	16.0	30.0	18.0	1 in 20	..	12.0	..	536	13
25	Stone Lane Bridge	,,	,,	,,	..	Wood, with stone piers	,,	..	9.0	45.0	18.0	Level	..	..	..	193	15
26	Spring Lane Bridge	,,	,,	,,	..	Ashler, with brick arch faced with stone	,,	..	16.0	30.0	18.0	1 in 30	..	8.0	..	418	19
27	Rainhill Bridge	,,	askew	,,	54.0	Ashler	,,	..	30.0	30.0	18.0	1 in 26	..	12.0	..	3735	6
28	Bourne's Tunnel.	,,	,,	over	14.0	Ashler and rubble	,,	..	104.0	7.0	7.0	..	..	..	..	165	5
29	Marshall's Cross Bridge	,,	square	under	..	Ashler	,,	..	24.0	30.0	18.0	1 in 20	..	5.0	..	864	13
30	Sutton Bridge	,,	,,	,,	..	Ditto	,,	..	26.6	30.0	23.0	Level	..	..	..	470	8
31	Sankey Viaduct	9	..	over	..	Brick, with stone-face qnoins & parapets	,,	Brickwk.	25.0	50.0	60 to	..	..	..	..	45,208	18
32	Legh's Cattle Archway	1	..	,,	..	Brick-work	None	Brick	..	12.0	6.0	..	..	..	..	257	18
33	Sandy Main's Bridge	,,	askew	,,	15.6	Ditto	Stone	,,	35.0	12.0	15.0	..	..	..	..	429	0
34	Newton Bridge	4	square	,,	..	Brick-work, with stone facing	,,	,,	25.0	30.0	27.0	..	..	..	..	5340	12
35	Parkside Bridge	1	askew	under	32.6	Brick-work	,,	,,	20.0	30.0	18.6	1 in 18	..	6.0	..	316	19
36	Lockingstump Lane Bridge	,,	square	,,	..	Ditto	,,	,,	20.0	30.0	18.0	Level	..	..	..	491	14
37	Kenyon Tunnel	,,	,,	,,	..	Ditto	,,	,,	..	30.0	19.0	,,	..	..	..	1703	19
38	Haidman's Bridge	,,	,,	,,	..	Ditto	,,	,,	12.0	30.0	20.0	1 in 9	..	..	3.6	434	7
39	Newton's Bridge	,,	,,	,,	..	Ditto	,,	,,	12.0	30.0	18.0	1 in 12	..	7.0	..	369	12
40	Broseley Bridge	,,	,,	,,	..	Ditto	,,	,,	20.0	30.0	18.0	1 in 18	..	7.0	..	663	4
41	Withington's Bridge	,,	,,	over	..	Ditto	,,	,,	35.0	12.0	14.0	..	Level	..	..	419	15
42	Duckinfield's Bridge	,,	,,	,,	..	Ditto	,,	,,	35.0	12.0	14.0	..	,,	..	..	323	10
43	Bury Lane Bridge	,,	,,	,,	..	Brick, with stone quoins	,,	,,	35.0	16.0	16.0	..	1 in 20	..	3.0	621	1
44	Glazebrook Bridge	,,	,,	ov. brook	..	Brick, with stone quoins and pilasters	,,	,,	35.0	30.0	30 ab. riv.	..	..	..	..	1754	8
45	Hodgkinson's Cattle Bridge	,,	,,	over	..	Brick	,,	,,	35.0	9.0	10.0	..	..	..	..	13	9
46	Chat Moss Frame Bridge	,,	,,	,,	..	Brick and timber	,,	,,	25.0	12.0	13.0	..	..	..	..	466	19
47	Legh's Brick Arch	,,	,,	,,	..	Brick	,,	,,	25.0	16.0	16.0	..	Level	..	..	513	9
48	Worsley Brook Great Culvert	,,	,,	ov. brook	..	Ditto	,,	,,	125.0	13.0	13 to wat.	..	..	..	..	1598	5
49	Trafford's Lane Bridge	,,	,,	over	..	Ditto	,,	,,	69.0	12.0	13.0	..	Level	..	..	589	6
50	Sandy Lane Bridge	,,	,,	,,	..	Brick, with stone quoins	,,	,,	25.0	16.0	21.0	..	,,	..	..	1098	18
51	Winton Skew Bridge	,,	askew	,,	31.0	Brick and stone pilasters	,,	Masonry	25.0	22.0	20.0	..	,,	..	..	1725	10
52	Canal (Duke's) Bridge	2	square	,,	..	Dressed ashler	,,	,,	25.0	25.0	12 to wat.	..	,,	..	..	1158	8
53	Monk's Hall Bridge	1	,,	under	..	Brick	,,	Red rock	36.0	30.0	18.0	1 in 18	..	6.0	..	453	19
54	Eccles Bridge	,,	sq. & ask.	,,	34.0	Brick and stone quoins	,,	,,	48.0	30.0	18.0	1 in 24	..	6.0	..	954	0
55	Whittaker's Mill Dam	,,	..	..	..	Brick-work and masonry	..	..	..	..	..	..	..	..	..	631	10
56	Stothard's Occupation Brid.	,,	square	under	..	Brick	Stone	Brick	12.0	30.0	16.0	1 in 14	..	5.0	..	31	19
57	Gore Booth's Bridge	,,	,,	,,	..	Ditto	,,	,,	18.8	30.0	18.0	1 in 18	..	5.0	..	417	13
58	Cross Lane Bridge	,,	askew	,,	30.3	Brick and stone quoins to arch	,,	,,	48.0	30.0	18.0	1 in 30	..	6.0	..	801	12
59	Jones's Bridge, No. 1.	,,	,,	,,	30.4	Brick	,,	,,	42.0	30.0	18.0	1 in 20	..	6.0	..	....	
60	Ditto ditto, No. 2.	,,	,,	,,	30.3	Ditto	,,	,,	42.0	30.0	18.0	..	..	6.0	..	559	14
61	Ditto ditto, No. 3.	,,	,,	,,	30.3	Brick and stone quoins	,,	,,	48.0	30.0	18.0	1 in 20	..	6.0	..	} 988	15
62	Oldfield Lane Bridge	,,	,,	,,	33.0	Ditto	,,	,,	48.0	30.0	18.0	1 in 13	..	7.0	..		
63	Irwell Bridge	2	,,	ov. river	65.0	Ashler	,,	Masonry	53.0	63.0	30 to R.	..	..	..	..	8795	4
	Sundry Culverts, Foot-Bridges, and Compensation in lieu of Occupation Bridges															4296	16
																£99,065	11

Art. IV.—EXPANSION OF STEAM IN LOCOMOTIVES.

The subsidence of the fever of speculation, which a few years ago so seriously afflicted our railway system, has had the happy effect of turning men's attention towards the achievement of such means of economy as will enable railways to bear up against the dissipation of those false hopes upon which many enterprises in a great measure depended. The magnificent ideas which, at the outset of the railway movement, prevailed almost universally, have collapsed into their proper insignificance on the application of the touchstone of common sense; and every element of expense, devoted merely to purposes of vanity and grandeur, has been ruthlessly eliminated by the hand of wisdom. The novelty of railway locomotion has now worn off; and the only question of importance which can arise, in reference to different enterprises, is, whether they will pay a good dividend. To this end the attention of railway managers is now unceasingly directed; and it is the grand object of ambition with engineers, to perform a railway service at the least possible expense; and one instrument of economy is the expansive principle, as applied to locomotives, which promises to be productive of great amelioration. The advantage of using steam expansively in engines of every description has long been known, yet in rotative engines it has, until very recently, been little applied; and its use, in the case of locomotives, is a very recent innovation. The managers of the Liverpool and Manchester Railway have been among the first adventurers in this field of improvement; and we purpose to lay before our readers the results of some experiments conducted by Mr. Woods, the engineer of that line, upon engines of different constructions in those parts which regulate the ingress and egress of the steam to the cylinder, with the view of ascertaining what mode of using the steam would be productive of the greatest economy.

The first set of experiments were made with the "Cyclops," of which the following are the principal dimensions.

	ft.	in.
Diameter of driving wheels	5	0
,, cylinders .	1	$0\frac{11}{20}$
Length of stroke . .	1	4
Area of fire-box . .	42·02 square feet.	
,, tubes . . .	284·20 ,, ,,	

To this engine is applied a certain description of mechanism, termed Gray's Expansive Gearing, (which being patented is commonly known,) for working the valves, whereby the engine-man has the power of admitting at pleasure into the cylinders, either a full charge of steam, or any fractional portion whatsoever of such charge.

The steam may be cut off after the piston has travelled through the spaces of 6, 7, 8¼, 9½, 10¾, 12, and 14 inches, the entire length of the stroke being 16 inches; thus the steam will act expansively through spaces of 10, 9, 7¾, 6½, 5¼, 4, and 2 inches, or more correctly, through spaces less than these by 1 inch, as the eduction pipe opens to the cylinder when the piston has arrived within one inch of the end.

The advantages proposed to be obtained by this arrangement are, to accommodate the power of the engine to the weight of the load it has to convey, or to the nature of the inclinations to be overcome; to communicate, in fact, a property of adjustment, in virtue of which, an engine, constructed for the transport of very heavy loads, might be adapted to the exigencies of an irregular and uncertain traffic, without entailing any unnecessary expenditure of fuel.

Mr. Wood's inquiries were directed principally to the following points:—

1st. To determine the relative consumption of fuel and water, with different degrees of expansion, in conveying trains of nearly equal weight, and otherwise, under similar circumstances.

2nd. To noting the comparative speeds obtained under the above cases.

3rd. To comparing the performances, both in respect to fuel and speed, with those of the best engines hitherto in use on the Liverpool and Manchester railway.

In pursuing the first inquiry, it was evidently indispensable to employ a precisely uniform quality of fuel; and with this view, as well as for the sake of comparison with other engines, the best Worsley or Hulton coke was selected, and placed on the tender, in the condition in which it is now generally used for the supply of the co-acting engines, viz., with all the dust and very small pieces separated.

FIRST CLASS TRAINS.

I. Steam cut off after the piston had travelled 7 inches, except in ascending the Whiston incline (1 in 96), when 9½ inches were admitted.

1. A train with 6 coaches, from Liverpool to Parkside, 5 from Parkside to Manchester. No help up the incline; 3 stoppages; water in tender hot.

Consumption of coke . 482 lbs.
,, of water . 332 galls.
Time, exclusive of stoppages, 55 minutes.

2. A train with 9 coaches, from Liverpool to Manchester. No help up the incline; 3 stoppages; water in tender hot.

Consumption of coke . 482 lbs.
,, of water . 415 galls.
Time, exclusive of stoppages, 60 minutes.

II. Steam cut off at 9½ inches, except in ascending the incline on the first trip, in which the quantity admitted was increased to 10¾ inches.

1. Train from Liverpool to Manchester: 7 coaches from Liverpool to Parkside; 5 from Parkside to Manchester. No help up the incline; 2 stoppages; water in tender hot.

Consumption of coke . 581 lbs.
,, of water . 415 galls.
Time, exclusive of stoppages, 52 minutes.

2. Train from Liverpool to Manchester: 6 coaches from Liverpool to Parkside; 5 from Parkside to Manchester. No help up incline; 2 stoppages; water in tender hot. The engine primed badly; in consequence of which the steam admitted was reduced to 8¼ inches between Newton and Manchester.

Consumption of coke . 584 lbs.
,, of water, of which much was lost by
Priming . . . . 523 galls.
Time, exclusive of stoppages, 64 minutes.

3. Train from Liverpool to Manchester: 6 coaches from Liverpool to Parkside; 5 coaches from Parkside to Manchester. Water in tender hot; no help up incline; 2 stoppages; and delayed from Bury-lane to Manchester (8 miles) by overtaking a Grand Junction railway train.

Consumption of coke . 610 lbs.
,, of water . 422 galls.
Time, exclusive of stoppages, 58 minutes.

The circumstance of overtaking, and following at a slow speed, another train, would render the consumption of fuel somewhat less than otherwise would have been the case, as the fire-door remained open several miles. The estimate of time occupied is only approximate.

4. Train from Liverpool to Manchester: 8 coaches. No help up incline; 2 stoppages; water in tender hot.

Consumption of coke . 736 lbs.
,, of water . 427 galls.
Time, exclusive of stoppages, 61 minutes.

SECOND CLASS TRAINS.

I. Steam cut off after the piston had travelled 8¼ inches, except in ascending the Sutton (1 in 89) and Whiston (1 in 86) incline planes, and starting from stations.

1. Train from Manchester to Liverpool: 8 coaches from Manchester to Parkside; 9 from Parkside to Liverpool. Water in tender hot; ascended Sutton incline with 10¾ inches of steam; no help; 20 stoppages.

Consumption of coke . 781 lbs.
,, of water . 530 galls.
Time, exclusive of stoppages, 124 minutes.

2. Train from Manchester to Liverpool: 8 coaches from Manchester to Parkside; 10 ditto from Parkside to Liverpool. Water in tender hot; ascended Sutton with 10¾ inches steam; no help; 18 stoppages.

Consumption of coke . 750 lbs.
,, of water . 498 galls.
Time, exclusive of stoppages, 118 minutes.

II. Steam cut off after the piston had travelled 9½ inches, except in ascending either of the planes, and in starting from the stations.

1. Train from Manchester to Liverpool: 9 coaches from Manchester to Parkside; 10 ditto from Parkside to Liverpool. 15 stoppages; helped up incline, the rails being slippery; water in tender hot.

Consumption of coke . 814 lbs.
,, of water . 568 galls.
Time, exclusive of stoppages, 110 minutes.

2. Train from Manchester to Liverpool, with 10 coaches. Up Sutton incline with 14 inches of steam; no help; 18 stoppages; water in tender hot.

Consumption of coke . 795 lbs.
,, of water . 613 galls.
Time, exclusive of stoppages, 113 minutes.

III. Steam cut off after the piston had travelled 10¾ inches, except when ascending planes, or starting from stations.

1. Train from Manchester to Liverpool: 5 coaches. No help up incline; 18 stoppages; water in tender cold.

Consumption of coke . 901 lbs.
,, of water . 486 galls.
Time, inclusive of stoppages, 97 minutes.

2. Train from Manchester to Liverpool: 9 coaches. No help; 15 stoppages; water in tender hot.

Consumption of coke . 830 lbs.
,, of water . 600 galls.
Time, exclusive of stoppages, 95 minutes.

LUGGAGE TRAINS.

Steam cut off at the following positions of the piston.

From Liverpool to 1¾ mile-post, 14½ inches.
1¾ mile-post to 2¼ ,, 12 ,,
2¼ ,, ,, 4½ ,, 10¾ ,,
4½ ,, ,, 7 ,, 9½ ,,

7 mile-post to	7¼ mile-post,	10¾ inches	Ascent at Whiston incline.
7¼ ,,	,, 8 ,,	12 ,,	
8 ,,	,, 8¼ ,,	14 ,,	
8¼ ,,	,, 9¼ ,,	10¾ ,,	
9¼ ,,	,, 10¼ ,,	9½ ,,	Rumball to Barton embankment.
10¼ ,,	,, 25¾ ,,	9½ ,,	
25¾ ,,	,, 26½ ,,	10¾ ,,	
26½ ,,	,, Manchester	9½ ,,	

or,

1½ miles at 14 inches.
1¼ ,, at 12 ,,
4¼ ,, at 10¾ ,,
23 ,, at 9½ ,,
Equal, when reduced, to an average of 10 inches.

1. Train consisting of 26 wagons, equal to 131 tons, 5 cwt. 3 qrs., from Liverpool to Manchester. Help up incline; water in tender hot; no stoppages.

Consumption of coke . 896 lbs.
,, of water . 639 galls.
Time of performing the trip, 78 minutes.

2. Train consisting of 26 wagons, equal to 137 tons, 9 cwt. 2 qrs., from Liverpool to Manchester. Help up incline; no stoppages; water in tender cold.

Consumption of coke . 910 lbs.
,, of water . 645 galls.
Time of performing the trip, 53 minutes.

It is observable that there is a little difference in the consumption of coal and water; the water being in the first experiment *hot*, and in the second cold.

ABSTRACT OF PRECEDING PERFORMANCES.

FIRST CLASS TRAINS.

Steam cut off at 7 inches.

	Coke in pounds.	Water in gallons.	Coaches.	Time in minutes.
1	482	332	5½	55
2	482	415	9	60
Mean.	482	373	7	57

Steam cut off at 9½ inches.

1	581	415	6	52
2	584	—	9	64
3	610	422	5½	58
4	736	427	8	61
Mean.	628	421	7	58

SECOND CLASS TRAINS.

Steam cut off at 8¼ inches.

1	781	530	8½	124
2	750	498	9	118
Mean.	765	514	9	121

Steam cut off at 9½ inches.

1	814	568	9½	110
2	795	613	10	113
Mean.	804	590	10	112

Steam cut off at 10¾ inches.

1	901	486	5	97
2	830	600	9	95
Mean.	866	543	7	96

LUGGAGE TRAINS.

Steam cut off, on an average, at 10 inches.

			Load in Tons.	
1	896	639	131 3	78
2	910	645	137 5	82
Mean.	903	642	134 4	80

The second inquiry refers to the maximum speeds attained with different degrees of expansion.

With first class trains—7 inches of steam admitted.

5 coaches down, 1 in 849, at 40·8 miles per hour.
6 ,, 1 in 1094, at 36· ,,

8¼ inches of steam.

6 ,, 1 in 1300, at 41 miles per hour.

9½ inches of steam.

5 ,, 1 in 849, at 43·8 miles per hour.
6 ,, 1 in 1094, at 40·0 ,,
7 ,, 1 in 1094, at 37·5 ,,
9 ,, 1 in 1094, at 36·0 ,,

With second class trains the rate per mile was not noted; but the time of performing the trip (30 miles) is given in the first table. When the steam was cut off at 8¼ inches (the train consisting of 8 or 9 coaches) the speed was not quite satisfactory, and the allowance was evidently too small for accomplishing the journey in the time required.

With luggage trains the rate per mile was not noted; but the time of performing the entire trip will be seen by reference to the table.

The results of the third inquiry are given in the following table:—

Averages of Four Trips.	Average Load.	Quantity of Steam admitted.	Hours at work.						Consumption of Coke.									Quality of Coke.
			In motion.		At Rest.		Total.		Whilst in motion.			Fuel dissipated in actual combustion and cinders.			During the whole day's work.			
									Total	Per trip.	Per mile	Total	Per trip.	Per mile.	Total	Per trip.	Per mile.	
			h.	m.	h.	m.	h.	m.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
Cyclops....	5¼	7 & 8½ inches...	5	15	10	55	16	10	2455	614	20·5	2783	696	33·2	2940	735	24·5	Worst
,,	8	8¼ & 7 ,, ..	6	13	11	17	17	30	2495	624	20·8	3177	794	26·5	3360	840	28·0	Best
,,	8½	9½ ,, ..	5	55	11	32	17	27	2774	694	23·1	3926	982	32·7	4032	1008	33·6	,,
,,	7	10¾ & 9½ ,, ..	5	29	12	1	17	30	3077	770	25·7	3822	956	31·9	3850	963	32·1	,,
Rapid.....	10	Full............	6	21	11	19	17	40	3816	954	31·8	4672	1168	38·9	4799	1200	40·0	,,
Leopard...	8	,, ...	5	56	10	52	16	48	3651	913	30·4	4773	1193	39·8	4890	1222	40·7	,,
Comet.....	7	,, ...	5	59	11	42	17	41	3164	791	26·4	3328	832	27·7	3780	945	31·5	,,

In comparing the relative consumption of fuel, the column headed "Coke consumed whilst in motion" should alone be used; the quantity burnt whilst at rest being subject to great variations, arising from the state to which the fire is brought at the end of the journey, and being, of course, entirely independent of the particular construction of the engines.

Of the other engines whose performances are given, the "Comet" has used least fuel, but the consumption still exceeds that of the "Cyclops." The loads of the "Cyclops," when working with 9½ inches of steam, were somewhat greater than those of the "Comet." But the total time, at rest and in motion, nearly corresponds; and there is a difference of consumption in favour of "Cyclops" of 390lbs.

With luggage trains, of equal size to those given above, the consumption was never less than 1100lbs. per trip. In the present instances, the average consumption was only 900lbs., and the saving of fuel, consequently, 200lbs. per trip.

Shortly after these experiments were made, a principle was adopted on the

Liverpool and Manchester Railway, which will be understood by referring to figs. 10 and 11, plate X., and to the following description:—

Stroke of slide valve . . .	5 inches.
Levers on weigh-bar shaft, top,	8 ditto; bottom, 6 ditto.
Throw of eccentric . . .	$3\frac{3}{4}$ ditto.
Angle of ditto	57° behind crank-arm.

The following table shows the states of the steam and exhausting-ports in one of the cylinders, in different positions of the piston; stroke 18 inches, divided into 100 equal parts.

Space passed over by piston.	No. 1 Steam-port.	Inch.	No. 2 Exhaust-port.	Inch.	No. 2 Steam-port.	Inch.	No. 1 Exhaust-port.	Inch.
0	Open to steam..	$\frac{1}{8}$	Open full exhausting...	$1\frac{3}{8}$	Shut..		Shut	
2	,, ..	$\frac{13}{16}$	,,	$1\frac{3}{8}$	,,		,,	
5	,, ..	$1\frac{1}{16}$	,,	$1\frac{3}{8}$	,,		,,	
10	,, ..	$1\frac{1}{4}$	,,	$1\frac{3}{8}$	,,		,,	
15	,, ..	$1\frac{1}{4}$	,,	$1\frac{3}{8}$	,,		,,	
20	,, ..	$1\frac{1}{4}$	,,	$1\frac{3}{8}$	,,		,,	
30	,, ..	$1\frac{3}{16}$	,,	$1\frac{3}{8}$	,,		,,	
40	,, ..	1	,,	$1\frac{3}{8}$	,,		,,	
50	,, ..	$\frac{3}{4}$	,,	$1\frac{3}{8}$	,,		,,	
60	,, ..	$\frac{3}{8}$	,,	$1\frac{3}{8}$	,,		,,	
68	Shut expanding..	0	,,	$1\frac{3}{8}$	,,		,,	
80	,, ..	0	,,	$1\frac{3}{8}$	,,		,,	
90	,, ..	0	Shut compressing	0	,,		Open ..	0
95	Open exhausting	$\frac{1}{2}$	,,	0	,,		,,	$\frac{1}{2}$
96	,, ..	$\frac{5}{8}$	,,	0	,,		,,	$\frac{5}{8}$
99	,, ..	$1\frac{1}{8}$	,,	0	,,		,,	$1\frac{1}{8}$
99½	Full open......	$1\frac{2}{8}$	,,	0	Open..	0	,, full	$1\frac{3}{8}$
100	,, ..	$1\frac{3}{8}$	Open to steam...	$\frac{1}{8}$	,,	$\frac{1}{8}$	,,	$1\frac{3}{8}$

Observe, that No. 1 steam-port, and No. 1 exhaust-port, are the same, denoting the passage leading to one end of the cylinder. No. 2 steam-port, and No. 2 exhaust-port, are the passage leading to the other end. When No. 1 is used as a steam-port, it must cease to act as an exhaust-port, and *vice versa*. By inspecting the table, it will be seen that the steam-port is $\frac{1}{8}$ inch open when the piston begins its stroke, and at the same moment the exhausting-port to the other end of the cylinder is wide open. The escaping steam is thus prevented from opposing a counter resistance to the piston. The steam-port closes when the piston has accomplished 68 per cent. of its stroke. The confined steam then acts expansively from 68 to 90 per cent., and finally escapes into the atmosphere between 90 and 100. The object of the lap is to allow the expulsion of the whole of the waste steam before the fresh steam is admitted; and the extent of the lap required (the dimensions of the ports being given) is determined by making the distance from the joint edge of the valve to the back edge of the exhausting space in the valve, equal to the extreme distance of the outer edges of the steam-ports; thus fig. A B = *a b*, a farther advantage is secured by working the steam expansively. The steam-ports are not opened quite full, as that would require a longer throw.

The following are the results of a series of comparative experiments made with the "Rokeby," an engine fitted with valves on this principle, and the "Cyclops," already described.

Proportions of the two engines:—

"Cyclops" has two $12\frac{11}{20}$inch cylinders equal to 247 square inches; 16 inches stroke; 5ft. $1\frac{5}{8}$in. wheel. At 80lbs. effective pressure of steam per square inch, the tractive effort may be thus calculated, supposing the steam to be admitted full stroke—

$$\frac{247 \text{ square inches } \times 80 \text{ lbs.}}{6{\cdot}05 \left\{ \begin{array}{l} \text{ratio of velocity between} \\ \text{piston and load} \end{array} \right.} = 3266 \text{ lbs.}$$

"Rokeby" has two $11\frac{1}{8}$inch cylinders equal to 194 square inches area; 20 inches stroke; 4ft. $11\frac{5}{8}$in. wheel. At 80 lbs. effective pressure of steam per square inch, the tractive effort may be thus calculated, supposing the steam to be admitted full stroke—

$$\frac{194 \text{ square inches } \times 80 \text{ lbs.}}{4{\cdot}68 \left\{ \begin{array}{l} \text{ratio of velocity between} \\ \text{piston and load} \end{array} \right.} = 3316 \text{ lbs.}$$

Whence it appears, practically speaking, the engines are of equal power, and should be able to draw the same maximum load under equal pressures, and under the conditions of the steam being admitted throughout equal proportions of their entire strokes.

Experience has shown that the "Rokeby," and other engines fitted with similar valves, can be made to do, under certain circumstances, the same amount of work as engines provided with the patent gearing, with an equally small consumption of fuel; but it was a matter of doubt whether the "Rokeby" class of engines could compete with the patent ones when employed in drawing very heavy loads; the one being able to command an admission of steam through 91 per cent. of the stroke, the other an admission of only 72 per cent.

To ascertain this point was the object of the following experiments:—

Twelve merchandize wagons, with low sides, loaded with scrap-iron, bricks, &c., so that each weighed exactly 5 tons gross, were provided for the experiments. The safety-valves on both the valves were weighted to 70 lbs. per square inch above the atmosphere; and, with a view of rendering the parallel more complete, the same thermometric pressure-gauge was employed for observing the pressures of steam in the boilers.

The Whiston incline was staked out into spaces of 220 yards, or a furlong each, by stakes numbered successively from 0 to 12—No. 0 being 40 yards distant from the foot of the plane (measured in the direction of its ascent), No. 12 corresponding exactly with the top.

The weather was very fine, and the rails dry and in excellent order.

The engines, with their loads, were brought opposite to the $5\frac{3}{4}$ mile-post, at some distance from No. 0, and thence starting from a state of rest, made the best of their way, with full steam on, to the top of the inclined plane.

It may be necessary to observe, that the road falls, from the place from which they started to the foot of the incline, at the rate of 4·82 feet per mile, from whence it rises at an angle of 1 in 96.

First Series with a one mile run into the plane. Load twelve wagons, = sixty tons.

	Time elapsed in travelling from starting point.		Differences of Times.		Speed in Miles per hour.		Pressure in Boiler.		Mean pressure.	
	Cyclops.	Rokeby	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.
	m. s.	m. s.	sec.	sec.	miles.	miles.	lbs.	lbs.	lbs.	lbs.
$5\frac{3}{4}$ M. P	—	—	—	—	—	—	74	87		
6 ,,	1·34	1·30	94	90	9·6	10·0	65	75		
$0\frac{1}{4}$,,	2·18	2·10	44	40	20·4	22·5	62	73		
$0\frac{1}{2}$,,	2·54	2·46	36	36	25·0	25·0	61	73		
$0\frac{3}{4}$,,	3·26	3·16	32	30	28·1	30·0	62	75		
0 ,,	3·41	3·30	15	14	30·1	32·1	62	75	62·7	73·0
1 ,,	3·55	3·43	14	13	32·1	34·6	62	75		
2 ,,	4·11	3·57	16	14	28·1	32·1	63	72		
3 ,,	4·27	4·12	16	15	28·1	30·0	64	70		
4 ,,	4·45	4·28	18	16	25·0	28·1	65			
5 ,,	5·5	4·44	20	16	22·5	28·1	68	72	66·8	71·3
6 ,,	5·25	5·1	20	17	22·5	26·4	68	72		
7 ,,	5·47	5·19	22	18	20·4	25·0	66	70		
8 ,,	6·10	5·38	23	19	19·5	23·7	64	73	66·2	70·8
9 ,,	6·36	5·58	26	20	17·3	22·5	64	71		
10 ,,	7·5	6·19	29	21	15·5	21·4	68	69		
11 ,,	7·36	6·40	31	21	14·5	21·4	69	70		
12 ,,	8·12	7·4	36	24	12·5	18·7	70	70		

In this experiment the "Rokeby" had the advantage over the "Cyclops" in point of speed; but it will be observed, that the pressure of steam in the Rokeby's boiler averaged during the ascent of the plane $6\frac{1}{2}$ lbs. more than the "Cyclops."

The difference of pressure at starting was still more considerable. These circumstances are sufficient to account for the increased speed. In the subsequent experiments, their respective pressures were more equally maintained by a judicious opening of the Rokeby's fire door, as this engine generated steam much more quickly than the "Cyclops."

Second Series starting near the foot of the incline plane. Load twelve wagons, = sixty tons.

	Time elapsed in travelling from starting post.		Differences of Times.		Speed in miles per hour.		Pressure in Boiler.		Mean pressure.	
	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.
	h. m.	h. m.	sec.	sec.	miles.	miles.	lbs.	lbs.	lbs.	lbs.
6¾ M.P.	—	—	—	—	—	—	89	85		
0 ,,	1·4	1·6	64	66	7·0	6·8	79	79	77·2	78·5
1 ,,	1·35	1·38	31	32	14·5	14·0	77	78		
2 ,,	2·6	2·8	31	30	14·5	15·0	76	77		
3 ,,	2·40	2·43	34	35	13·2	12·8	77	80		
4 ,,	3·15	3·18	35	35	12·8	12·8	80	81	80·2	80·7
5 ,,	3.52	3·56	37	38	12·1	11·8	83	81		
6 ,,	4·30	4·35	38	39	11·8	11·5	80	81		
7 ,,	5·8	5·15	38	40	10·8	11·2	78	80		
8 ,,	5·59	5·58	41	43	10·9	10·5	78	80	81·7	81·2
9 ,,	6·30	6·44	41	46	10·9	9·8	82	82		
10 ,,	7·13	7·32	43	48	10·4	9·4	85	82		
11 ,,	8·18	7·53	40	46	11·2	9·8	82	81		
12 ,,	6·36	8·36	43	51	10·4	8·8	80	82		

In this experiment the performance of the "Cyclops" is slightly superior to that of the "Rokeby," the difference amounting to one mile per hour at the plane. The "Rokeby" had 4lbs. less pressure on starting, which occasioned a trifling delay—in other respects the average pressure in the two engines was identical. The "Cyclops" made a previous unsuccessful attempt to ascend with twelve waggons. The pressure at the foot of the plane was then only 68lbs. per square inch. But notwithstanding this increased to 85lbs., the momentum was so much reduced that the engine came to a stand still at seven post.

Third Series starting near the foot of the plane. Load ten wagons, = fifty tons.

	Time elapsed in travelling from starting post.		Difference in Times.		Speed in miles per hour.		Pressure in Boiler.		Mean pressure.	
	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.	Cyclops.	Rokeby.
	m. s.	h. m.	sec.	sec.	miles.	miles.	lbs.	lbs.	lbs.	lbs.
6¾ M.P.	—	—	—	—	—	—	90	90		
0 ,,	0·58	1·0	58	60	7·7	7·5	83	85	79·5	8282
1 ,,	1·26	1·27	28	27	16·0	16·6	79	84		
2 ,,	1·52	1·53	26	26	17·3	17·3	78	81		
3 ,,	2·17	2·19	25	26	18·0	17·3	78	79		
4 ,,	2·44	2·45	27	26	16·6	17·3	78	76	74·2	74·5
5 ,,	3·10	3·12	26	27	17·3	16·6	75	75		
6 ,,	3·34	3·37	26	25	17·3	18·	72	74		
7 ,,	4·4	4·5	28	28	16·0	16·0	72	73		
8 ,,	4·31	4·32	27	27	16·6	16·6	76	74	73·2	74·2
9 ,,	4·59	5·0	28	28	16·0	16·0	75	74		
10 ,,	5·26	5·28	27	28	16·0	16·0	72	74		
11 ,,	5·55	5·56	29	28	16·0	16·0	71	75		
12 ,,	6·23	6·25	28	29	15·5	15·5	..	72		

In this experiment the performances are almost identical, there being only two seconds difference in the time of travelling, from the 6¾ mile post to No. 12 stake, a distance of 1¾ miles.

Although, by these experiments, it appears that engines with valves similar to those of the "Rokeby" are capable of drawing loads as heavy as the other description of engine; yet, there can be but little doubt, that an increased consumption is necessary to enable them to do so, and we think that the following experiment proves this position.

Upon the Liverpool and Manchester Railway, there are only two comparatively short inclines, and the "Rokeby" was accustomed to perform the duty with a consumption averaging about 19lbs. per mile run. Upon the Grand Junction Railway, however, (with longer gradients,) where this engine was tried for a day, the performance was as follows:

TRIP FROM LIVERPOOL TO BIRMINGHAM.

Load from Liverpool to Warrington . . 7 carriages.
,, Warrington to Birmingham . . 10 ,,

Time, exclusive of dead stoppages:—

	Actual Time.			Time allowed.	
	h.	m.	s.	h.	m.
Liverpool to Warrington . .	0	38	30	0	50
Warrington to Hartford . .	0	28	59	0	30
Hartford to Crewe	0	28	45	0	31
Crewe to Whitmore . . .	0	32	15	0	37
Whitmore to Stafford . . .	0	30	57	0	28
Stafford to Wolverhampton .	0	43	30	0	37
Wolverhampton to Birmingham	0	32	10	0	31
	3	55	6	4	6
Dead Stoppages . .	0	21	24	0	24
Total time	4	16	30	4	30

FROM BIRMINGHAM TO LIVERPOOL.

Load from Birmingham to Warrington, 12 and 13 carriages.
,, Warrington to Liverpool . . . . 7 ,,

Time, exclnsive of dead stoppages:—

	Actual Time.			Time allowed.	
	h.	m.	s.	h.	m.
Birmingham to Wolverhampton	0	35	20	0	36
Wolverhampton to Stafford .	0	31	30	0	26
Stafford to Whitmore . . .	0	39	35	0	36
Whitmore to Crewe . . .	0	22	45	0	21
Crewe to Hartford	0	29	0	0	25
Hartford to Warrington . .	0	29	45	0	27
Warrington to Liverpool . .	0	43	50	0	45
	3	51	45	3	36
Dead stoppages . .	0	21	5	0	24
Total time	4	12	50	4	0

Weight of coke pnt into the fire-box during the day, from the time of lighting the fire in the morning to the time of the return of the engine to Liverpool, = 4422lbs. ÷ 192 miles, = 23·0 lbs. per mile.

Consumption of water:—

Liverpool to Birmingham	1423 gallons.
Birmingham to Liverpool	1446 ,,
	2869

The "Hecate," an engine of the common construction, consumed, on an average, upon the Grand Junction line, 23lbs. per mile, and was able, under ordinary circumstances, to perform the journey within the given time: when tried upon the Liverpool and Manchester line for a day, the consumption on four trips, with an average load of seven coaches, was 20cwt. of coke, or about 18·7lbs. per mile.

Many of our readers will abuse us for the length of this article; but the subject is one of great importance; and to have excluded any of the results or statements, would have made the account imperfect, and we cannot, under such circumstances, repent of our prolixity. The conclusions to be derived from the whole are these:—That engines with their valves constructed like those of the "Rokeby," when employed npon a line where the duty is heavy, are not so economical as good engines of the common construction: nevertheless, this result may be affected by the pressure of the steam. The "Rokeby" was considerably behind her time in the down trip, as it is called, in which she had to contend with long and steep gradients; consuming, at the same time, much more fuel than she had been accustomed to do. It further appears that the principle of using the steam expansively may be applied, in the case of locomotive engines, with sncess, and that a very material economy cannot fail to result from that application.

ART. V.—CARPENTER'S MECHANICAL PHILOSOPHY.

Mechanical Philosophy, and its Application to the Arts. By WILLIAM B. CARPENTER, M.D. London: W. S. Orr and Co. 1843. Pp. 313.

THIS work forms the third volume of a "Popular Cyclopædia of Natural Science," now being published; and certainly, if all the volumes be as good as that before us, the said Cyclopædia must, we think, be popular in more senses than one. It would, perhaps, be equivocal praise to say that Dr. Carpenter has acquitted himself beyond our expectations, for there are very few of our academical heroes in whom we have much faith; but the work before us is a very useful and agreeable production, and involves the supposition of very considerable merit. There is not, it is true, any thing in it very profound, or very original: it announces no new discoveries, and throws no new light upon old ones; but it exhibits, in a convenient and attractive form, the leading principles of mechanical science, and illustrates them with an amplitude of detail which, though tedious, perhaps, to the more expert or proficient student, is, we think, extremely well adapted to make some impression on the mind of the general reader, in spite of the dulness and inattention which too frequently invest it. The difficulty of an achievement of this kind is very liable to be undervalued. It is, of course, impossible to say any thing very new about the mechanical powers, or the laws of gravity, and all these subjects have already received very good popular explanations: to be endurable, therefore, upon such questions, an author must explain them better than all who have gone before him; for where great excellence has already been attained, mediocrity is not to be tolerated; and as Dr. Carpenter has produced not merely a tolerable, but a very interesting volume, we are inclined, under the difficulty of the circumstances, to adjudge him as entitled to a liberal amount of praise.

The work is divided into twelve chapters. The first chapter treats of matter and its properties; and it is really surprising to find so threadbare a subject assume the interest Dr. Carpenter manages to give it. Our readers may take the following extracts:—

> "By *matter* we understand the *material* of which the universe is built up; and with this we become acquainted through our senses, which inform us of its properties; and as we find these to differ in different cases, we say that there are different forms of matter. We know just as much of any form or state of matter as our senses can communicate to us, and no more. A person deficient in one or more of the senses is shut out from any exact knowledge of the properties of which those senses inform us. Thus a blind man, who has been blind from birth, can form no proper idea of colour, nor a deaf man of sound. There are some bodies of whose existence we are informed by numerous senses, whilst others are known to us through one only. Thus, we receive information respecting the properties of a piece of cinnamon by the sight, the touch, the taste, and the smell; whilst those of a piece of flint are known to us only through the sight and the touch. We are aware of the existence of the planets and stars (which do not impress us with any perceptible warmth) only by the sense of sight. And there are many gases which are perfectly transparent, and do not possess colour, so that they cannot be distinguished by the eye, yet are at once recognized by the smell. Hence our knowledge of the peculiarities of different kinds of matter is limited by the nature of our senses; but the information which these communicate to us respecting it is so abundant as to serve all the purposes for which we can require such knowledge. It is wonderful how many ideas may be obtained respecting the world around, even by the sense of touch alone. Instances have occurred of children who were at the same time blind and deaf, and who possessed but little smell or taste; who yet, under the instruction of intelligent persons, have gained a large amount of information, and have been able even to comprehend the meaning of language."

The following definitions are very clearly put. They may, perhaps, be new to the less scientific portion of our readers:—

> "Though the term *fluid* is commonly regarded as having the same meaning with *liquid*, the scientific use of the two is different; and it is important to regard the distinction. The term *fluid* includes *all* those bodies of which the particles move readily upon one another,—in other words, all those which are not solid. But there is this important distinction among fluid bodies; that in some the particles have still a certain tendency to hold together, so that they always occupy the same space, however much the form of that space may vary; whilst in others, the particles have so little tendency to remain attached, that they always have a disposition to separate as far as they are permitted to do, and thus occupy the whole of any space within which they are confined. A given weight of water, for instance, will occupy exactly the same quantity of space, whatever may be the form or size of the vessel which holds it; and if we take away a portion, the remainder has no tendency to increase in bulk, to occupy the room of that which has been removed. But a given weight of air may be made to spread itself equally through the whole of a vessel of any size; and if a portion be taken away, the remainder will spread itself still more, so that still every part of the space shall contain the same amount of it. Again, if we fill a bladder or bag *quite* full of water, and strike it, we can make no more impression upon it by a blow (that is, supposing the walls of the bag not to be capable of extending themselves,) than we could upon a solid body; but if filled with air of any kind, the bladder or bag will yield to the blow, returning again, however, to its original form and size, as soon as the pressure is removed. Hence we see that there is, in reality, as great a distinction between these two classes of bodies as there is between fluids and solids: and they are scientifically divided into *elastic* fluids, namely, aeriform bodies, gases, and vapours; and *non-elastic* fluids, or liquids."

We cannot afford to multiply these quotations; yet we cannot resist giving the following, which has a specific interest for our pages, in consequence of the allusions to the Berlin castings:—

> "There is found at Bilin, in Germany, a deposit of siliceous (flinty) character, which occupies a surface of great extent, (probably the site of an ancient lake,) and forms slaty layers of fourteen feet in thickness. This bed supplies the *tripoli* used by artisans in metal for polishing their work; and also the fine sand employed to form moulds for casting small articles in Berlin iron; and it is partly on the fineness of this sand that the beauty and finish of these articles depend. For these purposes its consumption in Berlin alone is not less than from 50 to 60 cwt. yearly. It is almost entirely composed of the sheaths or coverings of a kind of animalcule which has the power of separating flinty matter from the water in which it dwells, and of producing out of this a sort of case analogous to the shell of a crab or lobster. The length of one of these is about the 1-3500 of an inch; and it is hence calculated that about 23 *millions* of them are contained in a cubic line of the sand, and 41,000 *millions* in a cubic inch. As a cubic inch weighs 220 grains, about 187 millions would be contained in a grain weight of this sand."

Chapter 2 treats upon the accidental properties of matter; chapter 3, on the attraction of gravitation; chapter 4, on the centre of gravity; and chapter 5, on the stability of structures. This chapter contains much interesting information respecting domes and bridges. Chapter 6 illustrates the laws of motion, and the composition and resolution of forces; and chapter 7 discusses the very important subject of central forces. The fault that we have to find with this chapter is, that it is too exclusively elementary. It explains very clearly that a coach, in going round a corner, is liable to be overset; but does not show how the amount of the centrifugal force is to be computed in the numerous important cases which arise in practice. Chapter 8, on the motion of falling bodies, explains very clearly a subject of much perplexity to ordinary readers. Chapter 9, on the pendulum, is imperfect. It contains no adequate account of the numerous ingenious contrivances in use for correcting the expansion or contraction of the rod, though encumbered with a considerable dissertation upon cycloidal pendulums, which are not in use at all. The length of the pendulum vibrating seconds in the latitude of London, has been very accurately ascertained, with the view of establishing some relation between this natural unit and the standard yard. The French have taken, as their natural standard, the distance from the pole to the equator, measured on the meridian line. This distance is divided into ten millions of equal parts, each of which is a metre, or 39·37079 inches; and the determination of the true length of the metre, according to the definition, is, of course, contingent upon the correct admeasurement of an arc of the meridian. In the year 1790 this project of a natural base was recommended to the French government by a commission of the Academy of Sciences, consisting of Borda, Lagrange, Laplace, Monge, and Condorcet; and it was immediately resolved that an arc of the meridian should be measured, extending from Dunkirk to Barcelona. The measurement of the northern portion was confided to Delambre, and of the southern portion to Méchain; but as some discrepancies were detected in the computations, it was resolved to extend the arc to Formentera, about thirty miles to the southward of the Balearic Isles. Méchain, however, having been carried off by fever, the completion of the task devolved upon MM. Biot and Arago. These measurements had the effect of reconciling the discrepancies before observed, and the result was accepted by the whole scientific world as correct. In the year 1838, however, Colonel Puissant, the author of a highly esteemed work on geodesy, ascertained that these measurements, or the calculations founded upon them, were, to a great extent, erroneous; and that, between the metre in use and the metre of definition there is a difference of $\frac{1}{5590}$th of the whole. The truth of this startling revelation has been confirmed by Mathieu, Largetau, and Daussy, to whom the question was referred.—These facts we have repeated, both because they have an important bearing upon the subject, and because Dr. Carpenter does not seem to have been aware of their existence.

Chapters 10 and 11 treat of the mechanical powers; and which, instead of forming the bulk of the work, as is the case in most instances, collapse, in Dr. Carpenter's hands, into their proper insignificance. The 12th and last chapter treats of friction. This is a very short chapter, and its brevity is to be commended; for the fact is, friction is a thing we even yet know very little about. It is not susceptible of exact mensuration,—is affected by a variety of accidental circumstances, such as the quality and quantity of the lubricating substance—and is also influenced by causes of which we know next to nothing. In spite, however, of these embarrassments, many of our academic oracles have introduced the element of friction into their mathematical mystifications, with as much solemnity as if it were a determinable and uniform quantity, like gravity or space. The result of all this, of course, is a vast accumulation of very profound nonsense, which scholars think very wise, and wise men think very foolish. Dr. Carpenter is not in the least afflicted with this besetting sin of "the college-bred;" and, throughout the work, has said nothing calculated to compromise his reputation with practical men. There are few of his cloth for whom we could say as much.

There is another eminent praise to which Dr. Carpenter is entitled: his book comes fully up to the present state of mechanical art; and although the science of mechanics has long been so completely developed as to preclude the possibility of any very important revelation being now added to it, the various apparatus representative of those principles are undergoing constant improvement, and new combinations are continually being devised. It is from these modern instances that Dr. Carpenter's illustrations are derived; and the work is, therefore, very far from being a mere digest of more ancient treatises. Thus, under the head of bridges, we are made acquainted with the peculiar structure of the wooden bridge which crosses the Schuylkill, at Philadelphia; and which, with a versed sine of only 20 feet, has a span of 340. The suspension-bridge over the Avon is likewise adverted to; the proposed application of the suspension principle to large roofs; the diagonal trussing of Sir R. Seppings, for ships; and a variety of other important applications. There is, also, a very good statement of the effects of percussion in superinducing crystallization in malleable iron,—a change to which the fracture of railway axles has been attributed; and a large fund of other highly interesting and important information, bearing upon the present condition of the arts. This information, moreover, is not only new, but selected with great discrimination; and, in the whole compass of the work, we believe very few, if any, statements will be found, the orthodoxy of which can be called in question.

We shall look for the future volumes of this Cyclopædia with much interest. If they are of equal goodness to the volume before us, and the subjects be judiciously selected, the series must take the precedence of all similar works; and certainly not the less so in consequence of the price being so moderate. We have rarely met with a better executed book than the present volume. The style is elegant and perspicuous, the doctrines just, and the illustrations selected with judgment. The work is, in short, an excellent one, and such as could have come only from the hand of a master.

ART. VI.—OUR CLUB. No. III.

May Literature and Science now
 Like bright twin stars united be;
And Genius deck pale Wisdom's brow
 With garlands wreath'd by Poesie;
While every gift and every grace
 Which Nature showers on favour'd man,
Conspire to leave their radiant trace
 In the undying Artizan.

SCENE—*The Club Room.*

Present—SIR JONAH, MONTGOMERY, GRAY, *and* SCALPEL.

(*The curtain, on rising, displays* SIR JONAH *reclining on a sofa, reading and falling asleep by turns; and* MONTGOMERY, GRAY, *and* SCALPEL *discoursing with wisdom.*)

SCALPEL. The laws of accelerated motion, and, indeed, all about momentum, power, and work, have ever been to me a standing puzzle. Now here is a question:—If you double the velocity of a steam-vessel without altering her immersion, how many times must her power be increased?

GRAY. Eicht times.

SCALPEL. And why eight times? The useful effect is only doubled: that is, you only accomplish double the useful effect in the same time; and why should not the power exerted be simply proportional to the effect produced?

GRAY. So it is; but that effeck isna a' *benefeecial* effeck: a pairt is wasted in gien motion to the particles o' the water in which the vessel moves.

SCALPEL. Yes, that I can understand; and therefore, railway and steam-packet locomotion are so far incomparable. In the case of a railway, the power exerted in moving a load through a given distance, is nearly the same, whatever be the velocity—that is, leaving out of account the element of atmospheric resistance: whereas, in the case of a steam-vessel, the particles of the water which the vessel encounters have to be set in motion with a velocity corresponding to that of the vessel's progress. But, in any given distance, the vessel only encounters the same number of particles.

GRAY. But thae particles impinge on the vessel at dooble the velocity.

SCALPEL. Yes, and therefore should exert double the retarding force in the same distance, and four times the retarding force in the same time. In other words, if you double the speed of the boat, you will double the velocity of displacement of the particles of water; and as double the power is requisite to produce double the velocity in those particles, it will require double the tractive or impelling force to give the vessel double the speed. But this doubled pressure acts only for half the time; therefore, for the whole time, a four-fold power will be necessary.

MONTGOMERY. Your argument involves a fallacy.

SCALPEL. I should like to know where. Nothing can be clearer—that, as double the pressure impeding the progress of the vessel is exerted at double the speed, the power in the engines in a steam-boat must act with double the energy; but they must also work at double the speed: in other words, if the speed of the boat be doubled, the engines must act with four times the power. Q. E. D.

MONTGOMERY. True: what was to have been proven, but, also, what yet remains unproved. It is not the fact, that double the urging force will universally impart double the velocity to bodies: and, in this particular case, I think I shall be easily able to show that your theory is erroneous. The particles of water which impinge on the bow of the boat must be moved horizontally from the place they impinge on to the extremity of the vessel's breadth; and if you double the velocity of the boat, you must halve the time in which this transfer is performed. Now, by the doctrines relative to motion produced by a uniform pressure, it is found, that to make a body describe the same space in one half the time, four times the pressure must be exerted. In the case of gravity, for example, a body falls through a space of 16 feet in a second; and it is easily shown, that, to fall through 16 feet in half a second, the force of gravity would require to be increased four-fold.

GRAY. That's quite obvious, frae considerin' the laws o' the progression. The velocities, ye ken, are as the times, an' the distances as the squares o' the times.

SCALPEL. Ha! I think I see it, though as yet very confusedly. I may explain my conceptions thus:—The power given out by a heavy body in descending through space, is directly proportional to the space descended through. Thus, if 33,000lbs. descending through a foot be equivalent to a horse-power, the same weight descending through half a foot will be equivalent to half a horse-power; and this without reference to the time in which the descent has been performed. The power, therefore, generated in a heavy body in falling, is directly proportional to the height fallen through, while the velocity attained is proportional to the square root of the height fallen through, or, what is the same thing, to the square root of the power expended in putting the mass into motion: that is, the power expended is as the square of the velocity. Therefore, to move the particles of water displaced by the vessel with double the speed, a four-fold mechanical power must be exerted.

MONTGOMERY. The conclusion is right, though not deduced very logically. The argument I have used cannot be made very clear without a reference to the laws of accelerated motion; but, if you look into the account of the experiments with Atwood's machine, you will see it stated very intelligibly. There are few mechanics, I fear, who have any very clear conception of the theory of falling bodies.

SIR JONAH (*soliloquizing.*) O! what a fall was there, my countrymen!

GRAY. As soun' as the Peeramids.

SIR JONAH. Fallen from his high estate, and weltering in his dulness.

MONTGOMERY. No, not asleep; only in a fit of the poetics. O!—I see, it is the Edinburgh Review he has got hold of: it probably calls up some old associations.

GRAY. Belike aneuch.—(*To* SIR JONAH.)—Winna ye, sir, mak' us partakers in your diversion?

SIR JONAH. Diversion, indeed. Who would have thought it—mere lead-dross. But there is one article here of the workmanship of genius, and which redeems the heaviness of the rest, while, at the same time, making their evil qualities all the more conspicuous by contrast.

GRAY. Whatna article is that?

SIR JONAH. The review of the Recreations of Christopher North.

MONTGOMERY. Another son of genius.

SIR JONAH. Yes, but not in all cases a pleasing writer.

SCALPEL. To me his writings have always been like Noyeau—delicious in small quantities, but not to be endured in bumpers.

SIR JONAH. That is chiefly because he is too ornate: people will never continue to like any style which has not a plain frame-work. A writer of genius, who is uniformly eloquent, will be admired, and neglected.

MONTGOMERY. Christopher's genius is like the meridian sun, dazzling and unapproachable. Like it, too, it has its spots, and is sometimes oppressive from its excess of fervour.

SCALPEL. With great genius, he is deficient in taste—his images are occasionally displeasing—his transitions too abrupt, and his representations tinged with vulgarity. The truth is—but I must tell you in a whisper—admirable as Christopher is, you cannot resist the conviction that he is not a gentleman.

GRAY. I'll no sit an' hear it said. What—run doon Christopher North, the greatest genius o' the age, an' a Scotchman tae! Ma feth, ye're no blate. An' what though he binna a gentleman, in your sense o' the word—he's a man an' a genius; an' that's far better. He has owre muckle sense to be a gentleman—a kin' o' silly booin' chivalry cretur, half man an' half woman—an' half naethin' ava. I never yet kent a gentleman that was worth tippence.

MONTGOMERY. You two are not likely, I think, to come to the same way of thinking. What says Jeffrey?

SIR JONAH (*reads.*) "When the main object is to arrange and systematize long-established results; to present these in a compact shape; to compile a Hand-Book of Criticism for every-day use, we grudge every excursion of fancy, and press on 'as one who bates not till his journey's end.' The goal being plain from the first, the object is, to make the highway to it as short and smooth as possible. But it is otherwise with the *non inventa sed quærenda*. Where criticism comes to deal with new products of imagination; to sound and fathom the currents and tendencies of a new literature springing up out of the changing aspects of things; to point out the mode of its growth, the probability of its direction; its relation to what preceded it;—in what respects it is the independent expression of the individual mind, in what the result of a mere social necessity; what in it is likely to be permanent and unchangeable—what the mere reflection of temporary tastes, and fashions, and prejudices, soon to be superseded by other modes as transitory in their turn;—fully to perform this task, criticism must be indulged with a *poetry* no less than a *philosophy*."

GRAY. Oor ain words amaist! He's quite richt.

SIR JONAH. It is too long to read right through; but you may take this:—(*reads*)—"Against a grave argument addressed to a man's follies or prejudices, some show of argument can always be opposed. Sometimes, in the opinion of others, the party challenged may even leave the field a victor; but, present the obnoxious weakness in its naked absurdity, surround it with its comic accessories, and it shall go hard but that conviction will be produced, if not in his own mind, at least in those of all who witness the gentle Passage of Arms."

GRAY. You're makin' that oot o' your heed—it canna be in the byuck.

SIR JONAH. It is, *verbatim.*

GRAY. An' whan 's the date?

SIR JONAH. February, 1843.

Gray. The same date as oor ain, an' the words amaist identical. Ye maun hae wrote that article yoursel, sir.

Sir Jonah. No.

Gray. Then it 's plain Jaffrey had some haun' in oors.

Scalpel. I have suspected as much all along. There is an extraordinary similarity between the style of some of your articles and that of his.

Sir Jonah. The subject is esoteric: we cannot reveal the mysteries of our function. What letters are there?

Montgomery. This pile is composed of complimentary effusions, some in prose, and some in verse; and here is one which performs the much more useful service of telling us of our faults.

Sir Jonah. Let us thank our stars we are at length like humanity. I was afraid at one time that we were going to have no faults at all. Let us hear that letter by all means.

Montgomery (*reads.*) " I have before me No. I. of the Artizan. The *style* in which you have produced that work fully entitles it to the patronage of the public."—

Gray. Hoot, that's the auld story. I thocht it was to rin us doon. Ye hae shairly got haud o' the wrong yepistle.

Montgomery (*continues.*) " But I cannot but warn you of its certain failure in London, if you allow partial statements and invidious comparisons to fill its columns."—

Gray. Nae doot. He's quite richt there.

Montgomery (*continues.*) " I allude more particularly to the article under the head of the 'Tagus' steam ship. Now, sir, we in London have become so used to the 'bravache' of the Clyde builders and engineers, that we have long since ceased to give it a moment's consideration. Indeed, we have the good fortune so frequently to rebuild and refit their vessels, after little or no service performed, that no notice is required to be taken by us; the matter speaking for itself, in language that directors are too frequently obliged to hear."—

Scalpel. So be is a builder himself, it would appear. Perhaps he thinks, in consequence of your having praised a Clyde-built ship, that all the ships built there for the future will be so good, as to deprive him of *the good fortune* of refitting them, after little or no service. Can any deduction be more logical?

Montgomery (*continues.*) " I fully agree with you, that good ships can and may be built in the Clyde; but I affirm, that after twenty years' experience in such vessels, I never knew one built in the Clyde that could be compared to a river-built ship. The difference, I admit, exists not so much in point of workmanship as in quality of material, and in the decorations. I agree with you, that much taste is displayed by the Clyde artizan; but, for the comfort of passengers, there exists as much advantage in the London ships over the Clyde-built, as there is difference in their durability, and strength of their hulls. It is a pity, sir, that you should have allowed the article in question to be inserted as it arrived from the factory of Messrs. Scott and Co., without exercising your editorial pruner; and the only reason I can assign for so fatal an omission is, that you yourself must be closely connected with Clyde builders and engineers.—I am, sir, A London Mechanic."

Scalpel. But a most unfair sample of London mechanics, who, for the most part, are persons of merit and ingenuity. I never met with a greater abortion in the shape of a vindication.

Montgomery. As weak as it is unmannerly. We said the "Tagus" was a very excellent vessel. Does this man show she is not? We said she was Clyde-built. Is the allegation disproved? But then, after an experience of twenty years, this gentleman finds that Clyde ships are not so good as Thames ships; and therefore the "Tagus" is not so good as if she had been built a few degrees farther to the southward. And why? Not because the Clyde builders are deficient in taste, or science, or judgment, but because the materials of the Clyde are not so good as those of the Thames;—as if materials were dug out of the earth on the spot, and did not in each case come from the self-same market.

Scalpel. The three materials used chiefly in ship-building are copper, teak, and British oak; and those materials are supplied to the Clyde and Thames from the same mines and the same forests. Wherein, then, can be the difference?

Gray. Maybe in the air.

Montgomery. And then, indeed, we are partial and invidious, because we state the unbiassed truth; and, that what we have stated is the truth, this recusant is unable to deny. All that he attempts to do, is to attribute motives,—the last resort of every desperate and disingenuous antagonist. What answer shall I set down against this Avatar's missile?

Sir Jonah. None. When he has learned to write as a gentleman, he may, perhaps, be answered as one. But I must not let the London mechanics suffer by his clumsy championship; for we will ever hold the balance fairly. The fact is, there are far more bad vessels built in the Clyde than are built in the Thames; but there are some vessels built in the Clyde as good in every way as any built in the Thames; and of these good vessels, the "Tagus" is one. As regards exactness of carpenter workmanship, properly so called, the Thames has perhaps the advantage; and as regards high finish, the Clyde has the advantage; as is admitted, indeed, on all hands. Comfort to passengers depends chiefly on internal arrangements alien to the qualities of carpentry; and in those points the Clyde vessels are not deficient. And nothing can be more absurd than to maintain that good materials are not as procurable in the Clyde as in the Thames, or that ships built in the latitude of Glasgow must necessarily be worse than those built a few degrees farther south. In ship-building proficiency, the advantage, probably, on the whole, rests with the Clyde, and in engineering science with the Thames.

Gray (*surveying the Dutchman.*) Peety me, it 's past the twal, an' here we hae been sittin' the nicht as grave as the book o' Lamentations, an' hae na had a sang o' ony kin'.

Scalpel. It is too late to strike up our fairy-like music, or sweet melody, to-night; so we must even bottle them up until our next jollification.

Art. VII.—TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

Transactions of the Institution of Civil Engineers. 3 vols. 4to. John Weale, and Longman and Co. London. 1842.

In our last notice of these volumes we had a good deal to say of Mr. Parkes; and his contributions are not yet exhausted. His zeal in the service of the Institution has been so great, that four papers from his pen occupy nearly one half of the last and largest volume of its Transactions. Two of these papers we noticed last month; the other two contain the exposition of Mr. Parkes's new theory of the percussive action of steam in the Cornish engines; and as the author gained considerable notoriety by the originality, if not by the profundity of his speculations on this subject, we shall now resume our review of the Transactions, by making a few observations on the percussive theory, as we find it expounded in Mr. Parkes's two papers on that subject.

The author states that he was first led to the adoption of this theory by finding that the power of the Cornish engines, calculated in the usual way, was inadequate to the performance of the work they were proved by direct experiment to accomplish. In the first of the two papers relating to this subject he has given calculations of the power of three Cornish engines; but for only one of these has he correct data from which to calculate; for in two of the engines he has no exact measurement of the quantity of water evaporated. For one of these, indeed, he has a sort of *estimate* of the quantity of water evaporated, based on the number of strokes, and size of the feed-pump plunger; but this is far too uncertain a foundation on which to build a theory of the sort; and for the other engine he has not even this amount of certainty. For it he only knows, by direct experiment, the quantity of coals consumed; and he *assumes* that the relative evaporation is the same as in the others. Yet the whole calculations are made to hinge on this very datum that is so imperfectly supplied. This defect goes far to invalidate any new theory that may be based on the calculation of the power of two of the engines. The third engine whose power he has calculated is the engine at Huel Towan, which was experimented on by Mr. Henwood, and for it Mr. Parkes has got all the necessary data determined by actual experiment from Mr. Henwood's paper in the second volume of the Transactions. Leaving, therefore, the evidence derived from the other two engines to go for what it may be thought to be worth, we shall take a short review of the way in which the percussive theory is established from the experimental results of the Huel Towan engine.

Mr. Parkes's calculation of the power of this engine on the commonly received principles, brings out the result, that the power of the steam is sufficient to move the load of the engine over only five-sixths of the stroke; or, in other words, that the calculated power is adequate to perform only five-sixths of the work that is actually accomplished. He farther finds that the steam must enter the cylinder with a velocity of 600 feet per second; and this, he says, is such an enormous velocity, that the momentum of the steam at such a speed must cause a very great pressure on the piston, and that this must be the source of the additional sixth part of the power that is required to do the work. Now, taking it for granted, in the mean time, that Mr. Parkes's calculation of the power of the engine on the received principles is correct, his conclusion is certainly not very logically drawn from the premises. Before he can properly attribute so much virtue to the steam's percussive action, he ought to show, not only that the steam's simple pressure is deficient in power, but, also, that its percussive force is just sufficient to supply the deficiency. This he has not attempted, but contented himself with the simple assertion, that, as the velocity of the steam is very great, the power derived from that velocity must be very great also. We shall endeavour to enlighten Mr. Parkes a little on this point, by bringing to the test of calculation what amount of power, according to the received laws of Mechanics, really is derived from the impact of the steam on the piston; and in doing so, we shall take all the data from Mr. Parkes's own paper. These are, that the weight of water that enters the cylinder as steam at each stroke, is 6·64 lbs.; that its velocity is 600 feet per second; that the area of the piston, deducting the area of the piston-rod, is 4988 square inches; and that the gross load to be overcome by the steam, is 18·01lbs. per square inch of the piston. But 1·25lbs. of this load is for imperfect vacuum. We take that off, therefore, and there remains 16·76lbs. per square inch of actual weight of pump-rods, &c., to be lifted. The whole weight to be lifted by the steam, therefore, amounts to

$$4988 \times 16\cdot76 = 73598\cdot88\text{lbs.}$$

Now, when one body in motion strikes another at rest (which the piston may be considered to be in regard to the steam), the resulting velocity is in the inverse ratio of the masses. In this case, therefore, the velocity produced in the piston, and weight connected with it by the impact of the steam, will be

$$\frac{600 \times 6\cdot64}{73598 + 6\cdot64} = \cdot0541 \text{ feet per second.}$$

Again, by the established laws of Dynamics, the space through which this velocity would raise the whole weight against the action of gravity, is

$$\frac{(\cdot0541)^2}{64} = \cdot0000457 \text{ feet.}$$

That is, the percussive action of the steam would of itself move the piston over somewhat less than one-five-thousandth part of the stroke (the stroke is 10 feet). When Mr. Parkes has proved (?) that this same percussive action moves the piston over more than one-sixth of the entire stroke, he says that the "result will appear startling." The result that *we* have obtained will also, we apprehend, appear startling—particularly to Mr. Parkes. It will now be pretty evident, that whatever apparent deficiency of power there may be in the elastic force of the steam of the Cornish engines, it cannot be supplied from its force of impact; but an examination of Mr. Parkes's calculations will show that they are entirely erroneous, and that there is, in reality, no reason to suppose that there is not to be found, in the simple elastic force of the steam, a supply of power amply sufficient to produce all the observed effects.

At the very commencement of the calculation of the gross load on the piston, or of the whole amount of resistance opposed to the steam, Mr. Parkes is at a loss for the amount to be allowed for friction and imperfect vacuum, as neither of these has been found experimentally. He *assumes* them, both together, to amount to 7lbs. per square inch of the piston. Such assumptions as this may be allowable in ordinary calculations of the power of an engine, where, if we keep on the safe side, an error of a pound or two may be of no great consequence; but a new theory built on such a foundation must be but a very frail structure, liable to be overturned by the slightest breath of opposition. In the present instance there is even a strong presumption that these resistances are assumed too high. Mr. Wicksteed, writing *after* the publication of Mr. Parkes's paper, estimates (from "two years' experience") these resistances in the Holmbush engine at 2·45lbs., and Mr. Parkes himself thinks the Huel Towan engine should have only one pound greater resistance from these two sources than the Holmbush. If, therefore, Mr. Wicksteed is right, these retarding forces in the case under consideration would be only 3½lbs. instead of 7lbs.; and as the gross load is 18lbs. per square inch, a deduction of 3½lbs. amounts to more than one-sixth of the whole power of the engine, or fully the whole pretended effect of percussion. We do not presume to determine which amount is correct; but the *doubt* that exists is of itself sufficient to demolish a theory that has nothing else to stand on. We shall again, however, assume that Mr. Parkes is in the right: it is a good rule always to give the criminal the benefit of any doubt that may exist; and accordingly we waive the farther consideration of this point, and proceed to point out errors, as to which there can be no uncertainty.

The steam in this engine was cut off when the piston had moved over 26½ inches of its stroke; and Mr. Parkes finds, from Mr. Henwood's experiments, the quantity of water evaporated for each stroke of the engine; and from this, and the known relation that exists between the volumes of water and steam at different pressures, he finds that when the piston has described 50·7 inches of its stroke, the pressure of the steam will just be equal to the load on the piston, or 18lbs. per square inch. After this point, therefore, the deficiency of the steam's elastic force must be supplied by the momentum of the moving mass previously acquired. Mr. Henwood has given an indicator diagram, showing the pressure of the steam at the different parts of the stroke; and, from it, it appears that the mean pressure on the piston before the point where it became equal to the resistance, was 4½ lbs. above the resistance. Our author therefore argues, that 4½lbs. × 50·7 inches represents the momentum communicated to the moving parts before the steam pressure was reduced to an equality with the resistance; and that, consequently, more could not be given out afterwards. He calculates, from the relative volumes of steam and water, that, at the end of the stroke, the steam had a pressure of 7·3lbs., and that its expansion from 18lbs. to this final pressure, together with the momentum previously acquired by the moving parts, were capable of carrying the piston over an additional space of 48·29 inches, or 98·99 inches from the commencement of its stroke. The remaining 21·01 inches of the stroke still uncompleted must, therefore, have been performed by an additional momentum acquired at the commencement of the stroke by the steam's percussive action. Now we pass over all the minor errors of calculation that might be detected in these various processes; but we beg to call attention to one very extraordinary one, that at once destroys the whole conclusion. The amount of the momentum communicated to the piston before the steam pressure was reduced to an equality with the resistance, is calculated from the excess of pressure shown by the *indicator;* and, if there really was any power exerted on the piston arising from percussion, it is clear that that power, whatever it might be, would act equally on the indicator, and is, in fact, included in the 4½lbs. of pressure above the resistance indicated by that instrument. From this it is evident that any additional estimate for the power of percussion is neither more nor less than reckoning so much of the power exerted twice over. This, indeed, is precisely what Mr. Parkes has done; and however glaring may be the absurdity of such a blunder, there is no crevice by which he can escape from the awkwardness of his situation, except by denying that the percussive power which acted on the piston at all influenced the indicator. Such an assertion as this, if it were made, would be of itself abundantly ridiculous; but, so far from hinting at anything of this kind, Mr. Parkes has devoted the greater part of his second paper on this subject to show that the percussive action of the steam acts very powerfully on the indicator, and adduces this as another proof of the accuracy of his theory.

Grand as this last blunder undoubtedly is, it must yield the palm to another that is yet to be revealed. This is nothing less than underrating the initial pressure of the steam in the cylinder by 15lbs. on the square inch, or the whole pressure of the atmosphere. This will be rendered quite clear by the following short calculation; and, be it observed, we take all Mr. Parkes's own data:—

The water acting on the piston in the shape of steam at each stroke, is ·1038 cubic feet. The steam is cut off at 2·2 feet from the commencement of the stroke, and the area of the piston is 34.6394 square feet. Hence, the volume of the ·1038 cubic feet of water, as steam, before it expands, is

$$34.6394 \times 2\cdot2 = 76\cdot2 \text{ cubic feet, or } \frac{76\cdot2}{\cdot1038} = 734 \text{ times its original volume.}$$

Now this ratio of the volumes is due to a pressure of 36¾ lbs. per square inch,* which must have been the pressure in the cylinder at that part of the stroke, instead of 22lbs., as given by Mr. Henwood, and adopted, without question, by Mr. Parkes. It is indeed extraordinary that Mr. Parkes did not discover this tremendous discrepancy between his data, for he is constantly referring to the indicator diagram for corroboration of his calculations from other data. We think it probable that Mr. Henwood, in making the pressures, just forgot the atmosphere altogether; but it is no business of ours to explain the blunders of Messrs. Henwood and Parkes. We leave that to them, and content ourselves with having pointed them out. We have now reached the climax of Mr. Parkes's splendid course of errors, and we think we have not only shown that the percussive theory remains yet to be proven, but that Mr. Parkes is a man of original genius. It is a common observation, that there is but a step from the sublime to the ridiculous; from which we infer the converse proposition, that a step will lift one from the ridiculous to the sublime; and this is well illustrated in these papers of Mr. Parkes. He has in them taken a step in advance, and, leaving petty and merely ridiculous mistakes behind, has attained the very sublimity of blundering.

Our observations on the papers connected with the Cornish engines have extended to such a length, that we must be much briefer in our notices of the remainder. We can, indeed, do little more than enumerate a few of the principal papers. The subject of bridges seems to occupy fully as large a share of the attention of the Institution as any other; and we have descriptions scattered through all the volumes of bridges of almost every variety, including accounts of the different methods adopted in the construction of the new, and repairing of the old. In every country bridge-building has been one of the first efforts of engineering skill; and as civilization and commerce increase, these structures have continued to afford the best examples of its victories over what might almost have been conceived the insuperable obstacles of nature. This department of engineering, too, affords, of all others, the best field for the display of the architectural taste as well as scientific attainments of the engineer. The subject also derives an additional interest in its present stage of advancement, from the many new materials and new methods of construction that have been introduced into the practice of bridge-building within the last thirty years. To our fathers "a bridge" meant one or more stone arches thrown across a river; but now, we have stone bridges, iron bridges, and wooden bridges; we have bridges over rivers, over seas, and over roads and railways; we have bridges to carry roads, canals, and railways; we have fixed bridges, suspension bridges, and even floating bridges. This immense increase in the variety of the purposes for which they are erected, and the materials of which they are composed, necessarily gives rise to new principles of construction, and new expedients for overcoming difficulties that were formerly either unknown or thought insuperable. All these considerations combine to make us rejoice that this subject occupies so conspicuous a place in the Transactions of the Institution of Civil Engineers. When a multitude of new plans and rival schemes are introduced into any department of the constructive arts, nothing contributes so much to thorough appreciation of the good, and the rejection of the worthless, as a careful register of the observed results of each. By this process, those plans that are radically bad are shown in their true colours, while those that are good are both preserved and improved. We are also glad to perceive that the members of the Institution have not confined themselves to any particular class of bridges, but that, in the volumes before us, we have examples of almost every kind that modern engineering has produced, and all of them more or less illustrated by drawings. On this point, however, we would suggest that the drawings would be more useful, and, consequently, more acceptable to engineers generally, if the detailed drawings were increased in number, even at the expense of curtailing, in some measure, the general elevations and perspective views that at present in many instances contribute more to the embellishment than the utility of these volumes. On the whole, however, the papers and accompanying drawings are useful and interesting descriptions of the works to which they refer, of the plans adopted, and the difficulties overcome in their execution; and they are also generally entitled to the praise of being well written because plain statements of the results of practical experience, collected by men who had the best opportunities of being well acquainted with their subjects.

Into the merits of the separate papers our limits will not allow us to enter.

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* This pressure is found from a very useful table of the relative pressures, volumes, and temperatures of steam given in Mr. Pambour's new theory of the steam engine, and adopted by Mr. Parkes in all his calculations.

We can only give the following list of the principal papers that may be included under this head. On stone bridges, we have—

Vol. I. Stone bridge over the Dora Riparia, near Turin, by B. Albano, Esq.
The Grosvenor Bridge over the Dee, at Chester.
Vol. III. Bridge over the Lea, at Stratford-le-Bow, by J. B. Redman.

On bridges composed chiefly of cast-iron arches, we have the following papers:—

Vol. I. The Lary Bridge near Plymouth, by J. M. Rendell, Esq.
Vol. II. Bridge over the Severn, near Tewkesbury, designed by Mr. Telford; by W. Mackenzie.
Vol. III. The Gravesend Pier, by William Tierney Clark.

On suspension bridges there are the following contributions in Vol. III.:—

One by General Pasley, on the damage sustained by the suspension bridge at Montrose during a hurricane.

A paper, by Mr. Provis, describing the undulations of the Menai bridge during gales of wind, and detailing the several injuries it has at different times sustained from these, and the methods proposed and adopted to remedy them. To this is added a paper, by Mr. Maudge, giving an account of the alterations and repairs as carried into effect in 1839.

On the subject of wooden bridges—a structure that is becoming more common as the cry for cheapness increases—there are two papers in Vol. II. The first of these, by Mr. William Bull, gives a description, accompanied with drawings, of the wooden bridge over the Calder, at Mirfield, Yorkshire. This bridge is only a light structure, intended for the passage of the horses used for hauling the barges on the river; but it deserves notice, as possessing a very large span in proportion to the rise of the arch—the span being 47½ feet, while the rise at the middle is only 11 feet; and it is remarkable, also, for its extreme cheapness of construction. It consists of one arch only, and Mr. Bull states that the masonry, approaches, and wooden arch, were finished for 743*l.* 8*s.* 5*d.*

The other paper we find on wooden bridges is by John E. Jones, describing Youghal Bridge, in Ireland. This is of a very different kind to the last, being carried over an arm of the sea, and extending to a length of 1542 feet. The arches are numerous, and only 30 feet span, supported on wooden piles.

It is, perhaps, hazardous to speak from the drawing alone; but, if we may be allowed to found an opinion on that, we think that Mr. Rendell's iron bridge over the Lary is entitled to a very high degree of praise for its elegance, and general appearance of lightness. This we attribute mainly to two circumstances, viz., the arches being elliptical, and the stone pillars terminating at the springing of the arches in place of being carried up, as is very usual, to the height of the roadway.

Another important class of papers to be found in these volumes, is that which embraces the details communicated to the Institution, of original experiments on various subjects connected with engineering and practical science. The chief of these papers are the following:—

Vol. I. An account of experiments to determine the expansion of water by heat; by the late Mr. Tredgold.
Experiments to determine the discharge of water by different shaped orifices; by Brian Donkin, Esq.

In these experiments some very curious results are discovered or confirmed.

Experiments on the resistance of barges moving on canals; by Henry Palmer, Esq.
Canal boat experiments; by John Macneil, Esq.

These were made on the Union Canal at Edinburgh, with the very light boats used for passengers on that canal, which, in speed, far excel those in use on most of the English canals. The experiments are very numerous, and the results valuable, although Mr. Macneil has not attempted to deduce from them any general theoretical conclusions.

In Vol. II. we have two more important experimental papers; the first on the strength of American timber, by Mr. W. Denison; and the second on the strength of cast-iron, by Mr. Francis Bramah. Both of these are comprehensive experimental inquiries into subjects of the deepest interest to all connected with the constructive arts. They both, at the time they were made, were valuable additions to our experimental knowledge of the strength of materials; but both, especially the first, are in some measure liable to an objection that applies to too many similar experiments—that of being made on too small a scale. We would suggest to future experimenters, that it would be much better to give comparatively few experiments, provided these were made on the scale of every-day practice. Such experiments would much more readily obtain the confidence of practical men, and justly so; for, in such materials as timber and cast-iron, where a very great degree of uncertainty prevails as to the uniformity of their quality in every part, experiments on square inches must be applied with extreme caution to the regulation of our practice, where the dimensions are to be measured by feet in place of inches, and the strains reckoned by tons in place of pounds.

We fear, however, that this dry enumeration of papers, of which our limits prevent us giving more than the name, is both tiresome and useless; and therefore, passing over many very interesting papers, we shall proceed to bring our remarks to a conclusion, by shortly stating the opinion we have formed of the whole; and, in doing so, it must be borne in mind that they are not to be looked on in the same light, nor judged by the same rules, as a book, or regular treatise on similar subjects. When an author appears before the public, it is properly expected that he should have availed himself previously of every source whence he could draw information connected with his subject; that he should have something new, if possible, in his matter—certainly in his style and method of treating the subject; and, finally, that he should be better acquainted with it than the generality of his readers can be supposed to be. If he is deficient in these qualifications, he deserves, in some degree at least, the censure of the critic; most certainly he can claim no more than his toleration. But the volumes now before us make their appearance under a very different character. They assume not to be treatises on any of the many subjects that find a place in their pages—they are professedly composed of unconnected facts, experiments, opinions, or even conjectures, that have from time to time been brought to light or suggested in the every-day business of the members of the Institution. They are, in short, the *disjecta membra* from which future theorists are to draw the materials by which new laws in science may be established,—which future authors are to digest into formal treatises, and by which future engineers are to guide their practice. In proportion as they appear calculated to serve all or any of these purposes, they are to be praised; and as every contribution to our knowledge of facts does more or less advance these objects, no such contribution, however trifling, is to be positively blamed, unless on the ground that its value is so exceedingly small as not to be worth the paper and print spent upon it. These are some of the immunities that papers like those now under consideration may justly claim at the hands of the critic; but they ought at the same time to possess other recommendations peculiar, in degree at least, to themselves. In proportion as they lose that connexion and interest which theory gives to detached facts, they may be expected to acquire a distinctness and copiousness of detail which may in all cases be derived from an author's personal and experimental acquaintance with his subject, and which is also eminently necessary to render his treatment of it of extensive utility. Where clear, well-defined, and well-founded principles are given, the minor details may safely be left to be determined by them; but where these are wanting, as they generally must be in the present case, nothing but an extra minuteness of detail can render the different papers in any high degree useful, or even safe, guides to those who may have to use them as such.

Our opinion of the Transactions, formed on these principles, is on the whole favourable; and it would have been much more so, if several of the articles had been entirely omitted. The great majority, in short, of those contributions which describe engineering works actually accomplished, or experiments and observations of facts in the conduct of engineering works, are valuable contributions to the general stock of knowledge on these subjects. The main defect of this class of contributions, and the drawings attached to them, is inadequate minuteness of detail; but this objection applies only to a limited extent; and the few papers in this class, that are trifling or unimportant, are at the same time the least voluminous. Those papers that deserve the most severe censure, are such as, while they add nothing to our experimental knowledge, aim at generalizing the facts, or correcting the theories of others; but, failing in the attempt, accomplish nothing but the exposure of the ignorance and presumption of their authors, and the fixing of a stigma on the discernment of the Institution which allowed them to disfigure volumes which they could not enrich. It will be readily allowed that an attempt to establish new principles, or destroy old ones, must be judged by a more severe standard than an unpretending record of the results of experience. The latter may be insignificant, but it is a part, however small, of the truth. The former may be false; and if so, may lead the unwary into error, while it can benefit none; unless, by being ably yet diffidently advanced, it tend to direct future experiments into that path in which they are most likely to lead to the establishment of true principles. To those who have read the previous part of our remarks, we need not say how little some of the theoretical papers in the Transactions are entitled to urge this palliative of their errors. We recollect only one paper of the theoretical class which the Institution would not have exercised a sound discretion in excluding. We allude to a paper by Mr. Farey, on the relative velocity and power of steam vessels. Mr. Farey is so much distinguished by the extent of his experimental knowledge, and his caution in generalizing on too narrow a basis of experience, that we are warranted in concluding that his views on this difficult subject are the result of a very wide induction; and they are advanced in such a diffident manner, as rather to invite farther inquiry than demand implicit confidence. Add to this, that they are compressed within reasonable bounds; and Mr. Farey's paper will be seen to have nearly all the merits that could be desired short of a complete exposition of the subject. We know not whether it was a certain lurking suspicion that the character of some of the papers was indefensible, that induced the Institution to prefix a slip to the third volume of its Transactions, intimating that it does not hold itself responsible for the opinions advanced by its members; but, whatever was the motive of this intimation, its utility must be very small; for, even without such a disclaimer, no one would have thought of fixing on the Institution one half of the contradictory opinions of its members, much less the absurdities of a few of them. The only responsibility that could attach to it is that of publishing unworthy communications; and *that* responsibility does and must fall on the Institution, in spite of all the disclaimers it can urge, so long as it selects those papers which are to be published.

Art. VIII.—THE LONDON BREWERIES.

It is not our present purpose to enter into any of those nice details connected with the process of brewing which affect the quality of the product of one brewery as compared with that of another, and which form attractive topics to practical brewers, and to them exclusively. Our ambition extends no farther, on the present occasion, than to give a general, and, so far, a superficial account of those interesting operations of which our great breweries are the theatre, and of the mechanical appliances by which those operations are carried on. We may thus hope to have a more extended, as well as a more promiscuous auditory, than if our remarks had been more scrupulously practical; and shall, moreover, be laying a foundation on which we may be enabled, on some future occasion, to build information of a more specific quality. It would of course be impossible, in any limits now at our disposal, to describe all the varieties of arrangement to be met with in different breweries in London, many of which appear to have originated in some peculiarity of situation, or other accidental cause. The best plan, it appears to us, will be to describe the apparatus and economy of one as an exponent of the rest; and we have pitched upon Messrs. Truman, Hanbury, and Co.'s brewery for that purpose, partly because it is one of the largest, but chiefly because it is, we believe, more complete than any of the others in its various mechanical arrangements.

Messrs. Truman, Hanbury, and Co.'s brewery is situated upon each side of Brick-lane, Spitalfields, and also upon each side of a street which runs at right angles with the preceding—the name of which we now forget. The extent of the business of this firm may be judged of by the number of horses they keep, which is 115. The stables in which these horses are lodged is really quite an elegant structure. The stalls are formed of wrought-iron plates, terminated by pillars, on which ornamental projections are cast for hanging the harness upon. There are no racks in the stables, nor wood-work of any kind; a circumstance which, we think, must add materially to the health of the occupants.

The stable contains stalls for 120 horses; and, in a separate building, there is an hospital for the sick. Attached to the stable is a machine for cutting the hay consumed by the horses, and rollers for bruising the oats. The oats and hay are not given to the horses separately, but mixed together, and the horses always eat either out of a bag or manger. It is not chopped hay, properly speaking, however, which is mixed with the oats, but chopped clover, sandfoil, and straw, in the proportion of four trusses of clover to two of sandfoil, and one of straw. To this quantity of chopped provender ten sacks of bruised oats are added; and of this mixture each horse consumes about 36lbs. daily.

The empty casks, on being brought into the yard, are sweetened preparatory to being re-filled, by admitting a current of steam into them. This is accomplished through the instrumentality of a number of nipples projecting above the floor of a shed, and over each nipple the bung-hole of a cask is placed. The steam is then turned on by means of a cock. An improvement has been lately introduced into this process, by following the jet of steam by a jet of hot water let in by a different cock and from a different boiler, but through the same nipple. This jet of water washes off any dregs or mildew that the steam may merely have loosened, and at once renders the casks fit for being again filled.

The most extraordinary part of this great establishment, or at least the part which will most forcibly arrest the attention of the visitor, is that called the "Tun-room." It is not that there is anything particularly striking in the mash-tuns, taken by themselves; but the great extent and great irregularity of the place—the variety of corkscrew and other stairs—of galleries, platforms, and recesses—of machinery of varying ages and constructions, now stopping and now going on, as may be requisite—these and other peculiarities of this giant chamber, which come upon the eye simultaneously, whilst the ear is at the same time met by a variety of unaccustomed noises—conspire to throw an air of romance over this part of the scene such as is not to be created by more orderly constructions, and can only result from a complication of subtle and conflicting associations. The emotions naturally called up, indeed, in ordinary minds by this spectacle, are very much akin in quality, though weaker in degree, to those awakened by a visit to some of the extraordinary salt-mines of the Continent, and appear, for the most part, to be made up of fear, bewilderment, and admiration.

The first step in the process of brewing is to heat the water requisite for making the mash. This is done in stupendous coppers, and the hot water is run from them into the mash-tun through a multitude of small holes in its bottom. The hot water, in its course, passes through a vessel called the "safe," the function of which is, to catch and retain any particles of grain, or other adventitious matter, which the water may carry with it, and which would choke the holes in the bottom of the mash-tun, if allowed to pass on. In the mash-tun the hot water and malt first come into contact, and within the tun are a number of agitators for mixing them more effectually. An ordinary mash contains about 240 sacks of malt. From the mash-tun the liquid is let off through the holes in its bottom into a vessel situated beneath the mash-tun, called the "Under-back," and as the holes in the bottom of the mash-tun are very small, the grains are unable to pass out with the liquid. The liquid in this stage is called "wort;" and the next step is to pump the wort from the under-back into the wort coppers, where it is boiled with the hops. From the coppers the liquid descends into the "hop-back," and from thence it is transferred by the wort-pumps to the coolers, which consist just of the floor of a room made water-tight, and furnished with a ledge all round to retain a shallow stratum of liquid. The cooling is hastened, when necessary, by a refrigeration, consisting of a congeries of copper pipes disposed in a subsidiary chamber a little lower than the main floor of the room. It must be, of course, unnecessary to remark that there are outlets for the escape of the steam into the atmosphere. The whole sides of the room, indeed, are made like a Venetian blind.

From the coolers the liquid passes into the fermenting-tuns, and from thence into vessels called "rounds," which very much resemble casks placed on end, where the porter or ale, as the case may be, is cleansed from the yeast. From thence it is collected into tanks, and from the tanks it is passed into vats, where it is stored, and from whence the casks required for the common supply are filled.

There is no essential difference in the process, whether the product is ale or porter. It is found, however, that ale is best fermented in small vessels, and porter in large ones; and instead of adding successive portions of water through the bottom of the mash-tun, so as to extract thoroughly the virtue from the malt, as is done in porter brewing, ale brewing requires any addition of water to be sprinkled over the digested mass at the surface, from whence it drains down through to the bottom, carrying with it the remainder of unextracted essence. The operation of sprinkling is accomplished by a sort of hair-brain Barker's mill extending across the tun, and running at a most unreasonable velocity. The rotation of this apparatus is of course achieved by the pressure of the head of water.

There are five great coppers in all in this brewery, two for ale, and three for porter; and the larger of these will hold about 500 barrels. Each copper is provided with a sort of receptacle or cistern above it, called a pan, for holding the liquid, out of which the boiler is fed, and which will hold about 250 barrels more; so that the content of a copper and its pan is about 750 barrels. The coppers are spherical with an arched bottom, and within each, two great horizontal arms with loops of chain attached to them are kept in revolution by machinery. This contrivance is called a "rouser," and is, of course, intended to prevent any of the contents of the copper from sticking to the bottom. There is in our eyes something very uncouth in this expedient, and, indeed, we think that brewers' coppers are altogether very far from the perfection to which it appears to us they might be brought. There would, of course, be infinite prejudices to overcome in any considerable innovation. All old established trades, indeed, are overgrown with prejudices—originating, perhaps, in some vain superstition, and remaining in full vigour after the parent tree has died away; and we firmly believe, that the more ancient of our arts have been, and are still vastly retarded by these frivolous and illusory agencies. It is only, however, among the more uneducated classes that such prejudices linger; yet, those constitute a large proportion of the persons familiarly known as practical men, and the most enlightened copartneries are for the most part loath to take any step in a matter of practical improvement, without the concurrence of their operative craftsmen. But however this may be, it appears to us that a great economy might be effected in brewers' coppers, by the introduction of some of those refinements which in sugar boiling and other similar processes have been practised with the most signal success. In particular, it appears to us that the heat expended in concentrating the wort might be rendered subservient to the achievement of evaporation in another vessel, the only necessary condition being, that in the two vessels the pressure should be something different.

A large proportion of the water requisite for the supply of this establishment is raised out of the well, lately described at the Institution of Civil Engineers, by Mr. Davison, the engineer of this firm. The content of the several water cisterns, or "liquor backs," as they are technically phrased, is 2,500 barrels. The daily consumption of water is between 6,000 and 7,000 barrels.

It has been from time immemorial the custom to make the vessels in which the fermentation is carried on of a square shape, and some species of occult virtue was supposed to reside in that particular form. These square vessels were for the most part supported upon brick walls, the space within which formed a receptacle for filth, mildew, and unwholesome vapours; yet, although these evils were obvious, no one liked to venture upon a change; and, indeed, it was very generally supposed that no other than square vessels would answer the purpose. This heresy the firm about twelve years ago was destined to overset: new fermenting tuns having been required for this brewery, they resolved to make them cylindrical, and to support them upon cast iron columns. The enterprise was rather a bold one at that time, and of course met with some distrust among the most superstitiously sceptical; but the innovation was so obviously founded upon sound scientific views that it met with the assent and confidence of all enlightened minds. The plan was carried into effect, and has been completely successful, the fermentation being if any thing better carried on in the cylindrical vessels, because more equally proceeding from a centre.

It would exceed our present limits to enter into any very minute details of the structure of these fermenting tuns. We may, however, state a few of the leading particulars. There are three tuns in all of this kind, arranged in a row, and each supported upon nine cast iron columns, one of which is of 12 inches diameter, is situated under the centre of the bottom, and the remaining eight, each of 6 inches diameter, around the periphery. From the central to each of the external columns, a girder extends to support the bottom of the tun, and from the head of each exterior column to the head of that adjoining it, a beam extends which partakes of the curve of the edge of the tun. These bracings are attached to the columns by dovetails, and throughout the whole of the attachments there is not an atom of wrought iron in the shape of bolts or straps, or indeed in any shape, employed. The weight which the columns sustain, when the tun is at work, is about 220 tons. The height of the columns is 14 feet, the height of each tun 23 feet, and its diameter 25ft. 6in. Each tun contains 1,250 barrels, up to the level of 15 feet.

Another most important application of cast iron Mr. Davison has recently made, is to the formation of floors for coolers. Heretofore, these floors have been exclusively of wood, but Mr. Davison has shown that iron is a better material in every respect, and one of its most important qualities is, that it achieves the requisite refrigeration much more rapidly than wood. With a wooden floor, indeed, refrigeration can only take place at the surface of the liquid; but with an iron floor, which is of course made thin, the refrigeration will take place both at the surface of the liquid, and the surface of the floor; the undermost side of the floor being kept cool by the current of air in the story beneath. Mr. Davison has lately erected a cooling house upon this system, of 140 feet in length by 56ft. 6in. in width; and it is found that a single flat of this cooling superficies with an iron floor is nearly as effectual as two flats with a wooden one.

We have only room to add a few particulars, which will, perhaps give novices a better idea of the extent of the operations of an establishment of this description than any thing we have said. The yearly number of barrels of beer manufactured is from 330,000 to 340,000. The annual consumption of coal is about 5000 tons. There are 139 vats on the premises, the greater number of which are about 25 feet in diameter, and from 20 to 22 feet high, and the connexions between the vats and other vessels is accomplished by between four and five miles of copper pipe, some of it of a large diameter, and none of it of a small. The hooping of the vats alone would, if opened out, extend a distance of 30 miles. There are in all above 70,000 casks: if placed end to end they would reach 38 miles, and the hoops of the casks, if opened out, would reach from London to the Land's End.

We cannot conclude this very cursory notice, without expressing our sense of the very great skill displayed by Mr. Davison, in all the mechanical and constructive details of this marvellous establishment. It is a few of them only we have now been able to allude to, and that too, as our readers can bear witness, but very imperfectly; but we shall take an early opportunity of describing less superficially such of his improvements as are the most remarkable for their merit, and the most applicable in other situations.

Art. IX.—TABLES OF RAILWAY GRADIENTS, &c.

We have had the following tables computed for the accommodation of that part of our readers more particularly interested in Railways. The mode of using them is so obvious, that it is unnecessary that we should say anything upon that subject.

RAILWAY GRADIENTS.

A rise of 1 foot per mile is	1 in	5280	A rise of 19 feet per mile is	1 in	277.9
1½	,,	3520	20	,,	264
2	,,	2640	22	,,	240
2½	,,	2112	24	,,	220
3	,,	1760	26	,,	203
4	,,	1320	28	,,	188.
5	,,	1056	30	,,	176
6	,,	880	32	,,	165
7	,,	754.3	33	,,	160
8	,,	660	34	,,	155.2
9	,,	586.6	36	,,	147.6
10	,,	528	38	,,	139
11	,,	480	40	,,	132
12	,,	440	44	,,	120
13	,,	406.1	48	,,	110
14	,,	377.6	50	,,	105.6
15	,,	355	55	,,	96
16	,,	330	60	,,	88
17	,,	310	66	,,	80
18	,,	293.3			

RAILWAY TIME AND DISTANCE TABLE.

	seconds	per hour.		seconds	per hour.
¼ of a mile in	20 is =	45.0 miles	¼ of a mile in	30 is =	30.0 miles
	21	42.8		31	29.0
	22	40.9		32	28.1
	23	39.1		33	27.2
	24	37.5		34	26.4
	25	36.0		35	25.7
	26	34.6		36	25.0
	27	33.3		37	24.2
	28	32.1		38	23.6
	29	31.0		39	23.0
¼ of a mile in	40 is =	22.5 miles	¼ of a mile in	66 is =	13.6 miles
	41	21.9		67	13.4
	42	21.4		68	13.2
	43	20.9		69	13.0
	44	20.4		70	12.8
	45	20.0		71	12.6
	46	19.5		72	12.5
	47	19.1		73	12.3
	48	18.7		74	12.1
	49	18.3		75	12.0
	50	18.0		76	11.8
	51	17.6		77	11.7
	52	17.3		78	11.5
	53	16.9		79	11.4
	54	16.6		80	11.2
	55	16.3		81	11.1
	56	16.0		82	10.9
	57	15.8		83	10.8
	58	15.5		84	10.7
	59	15.2		85	10.5
	60	15.0		86	10.4
	61	14.7		87	10.3
	62	14.5		88	10.2
	63	14.3		89	10.1
	64	14.0		90	10.0
	65	13.8		91	

Art. X.—THE BUILDING ARTS.

It is our intention to give a series of practical papers upon the more important sections of the constructive arts, so as to furnish carpenters, masons, and the other building artificers, with sound and useful information relative to their various trades. We shall, in all probability, begin with Carpentry, and will treat it on a similar plan to that we have adopted for illustrating the steam engine;—that is, we will endeavour to make the theory intelligible to the most unscientific, and follow up the theory by practical expositions and instructions; always bearing in mind, that the practical utility of any technical discourse is the test and measure of its value.

The want of a sound and practical discourse on the several branches of the building arts has long been severely felt; for although, in several of its departments, there are treatises of much ingenuity, yet we question whether they are not, for the most part, looked upon by practical men as too attenuated and hypothetical to be of any great utility to them, or to be safe guides or discreet advisers in actual practice. The information given in the Encyclopedias is generally, indeed, upon the whole, authentic; but it is almost all too antiquated for the present day, and is representative only of the practice of our grandfathers. We cannot spare room, however, at present, to convince sceptics, if such there be, of the reality of the want to which we have adverted, or of the reasonableness of our expectation to extinguish it; and must content ourselves with merely announcing our intention, which we will carry into effect as soon as we can consistently with the prior claims which other subjects have upon our pages.

Art. XI.—RAILWAY DEPARTMENT OF THE BOARD OF TRADE.

Report of the Officers of the Railway Department of the Board of Trade to the President of the Board. London. 1843. Folio. pp. 267.

The railway system of locomotion, when first introduced into this country, was managed with a considerable degree of safety to those who travelled by its means; but the public confidence that was thus secured, and the large profits derived from some of the first public lines of railway, superinduced a sort of railway mania, which displayed itself in the shape of an indiscriminate rush of speculators into almost every railway scheme that was propounded, no matter how absurd in itself, or suspicious in its origin. The necessary consequences of this headlong plunge into railway speculation soon began to show themselves generally in the shape of very small profits, and occasionally in there being none at all. The disappointment of the shareholders was great, and their cries for retrenchment and economy in their expenditure proportionably loud and vehement. This led to a general clipping and paring of many railway establishments; the number of the servants was reduced; and, generally, the attention of railway directors was turned to the working of their lines of railway with the minimum of expenditure, rather than the maximum of efficiency. The great freedom from accidents that the early railways had enjoyed, too, began at the same time materially to increase both the public confidence and the carelessness of railway managements. All these causes combined led, at last, to the almost simultaneous occurrence of extensively fatal railway accidents in all parts of England; a public panic was created; the value of railway stock was in many cases depreciated; and the clamour against the railway companies was so great as to force itself on the attention of Parliament, and necessitate the adoption of some legislative measures to secure the public in some degree from the jeopardy to which their lives seemed to be exposed by the recklessness of the railway companies. The general indignation at the fatal carelessness that had been frequently displayed, joined to the animosity of the various powerful interests that had been injuriously affected by the introduction of the railway system, seemed to point to the enactment of some very stringent measures of Government control over the railway companies; but the salutary dread of too great an interference with trading interests, or the progressive improvements of mechanical science, fortunately restricted the statutory provisions for securing the public safety, to the minimum amount that was necessary to accomplish any useful effect.

A new department was created, under the Board of Trade, for the supervision of railways; but the functions of its officers were almost entirely limited to the powers of inspection and giving advice, or remonstrating with the railway companies when they attempted to do any thing more than usually outrageous. Almost the only power of actual control vested in the new department, consisted in the authority given it to put a veto on the opening of any new line until the Government inspector should have certified that the works were in such a state of advancement and consolidation as not to endanger the safety of the trains passing over them. Under these limited powers the operations of this department of the Board of Trade have been advantageous. The Government officers, by a knowledge of their own weakness, have been careful not wantonly to interfere with arrangements which did not manifestly compromise the public safety; and the railway companies, on the other hand, sensible of this forbearance on the part of the Government, have rarely ventured to disregard admonitions addressed to them by officers whose authority was founded mainly on the support of public opinion.

That the safety of passengers by railway-trains has been materially increased since the institution of the railway department of the Board of Trade, is proved by the following extract from the Report now before us:—

> "In commencing our Third Annual Report on the proceedings of the Railway Department during the year 1842, it is very satisfactory to us to be enabled to call your Lordship's attention to the continued and progressive diminution in the number of accidents upon railways. In our last Report we gave an analysis of the returns of accidents made to this Department from the 12th of August, 1840, the date of the passing of the first Act for the regulation of railways, to the 1st of January, 1842; from which it appeared that the number of railway accidents of a public nature attended with personal injury, during the last five months of 1840, amounted to 28, by which 22 deaths, and upwards of 131 cases of injury, were occasioned; while during the 12 months of 1841 the number of accidents of a similar description amounted to 29, with 24 deaths, and 71 cases of injury. During the past year, the number of accidents of this description has been only 10, the number of deaths 5, of which only one occurred to a passenger while travelling by the train and observing the proper degree of caution, and the number of cases of injury only 14."

To the number of deaths within the last year, here specified, should be added another, that was occasioned by an accident on the Edinburgh and Glasgow Railway; but, as death did not ensue till some time after the accident, we perceive the case is entered in the returns as one of personal injury.

The following extract from the Report shows the very small amount of danger now incurred by railway travelling:—

> "A comparison of the number of accidents attended with death or injury to passengers, with the number of passengers conveyed by railway during the same period, which, from the returns made to this Department, appears to have been upwards of 18,000,000, would seem to indicate that the science of locomotion has, as far as the public safety is concerned, arrived at a very high degree of perfection; of more than 18,000,000 of passengers conveyed by railway in the course of the year 1842, only one having been killed while riding in the train, and observing the common degree of caution."

Notwithstanding the diminution of the number of accidents on railways, the Report is very earnest in its recommendations to the railway companies not to relax in the vigilance and care that have been so happily rewarded: and we think the reporters have formed a sound judgment, when they hold up as a matter of paramount importance the duty of securing, by every possible means, an establishment of steady, experienced, and trustworthy servants. The amount of danger that may frequently be avoided by the vigilance of the railway servants, is forcibly illustrated by this example from the Report:—

> "One remarkable instance of the manner in which the most formidable sources of danger have been averted by the activity and presence of mind of experienced and intelligent servants, is afforded by the slip on the west side of the Bughrook Cutting of the London and Birmingham Railway, on the 24th of November. This slip, which took place in a cutting that had stood for upwards of four years, quite as unexpectedly as that which, in December, 1841, caused such a disastrous accident on the Great Western Railway, was detected by the intelligence of an engine-driver, who, passing the spot about three hours before, observed that the rails appeared to be forced slightly out of their true gauge, and immediately called the attention of the nearest overlooker to the circumstance, who took prompt measures to watch the place, and give warning to the approaching trains. One instance like this is sufficient to show, how very different the return of railway accidents might soon become, if a mistaken economy were to induce the Directors of Railway Companies to reduce their establishments for watching the line, and to employ an inferior description of engine-drivers at lower wages."

We have here a striking illustration of the benefits to be derived from an effective establishment of well-trained and efficient servants on every line of railway. And there is another case detailed in this Report, which displays in a still more remarkable manner the lamentable consequences which may be expected to ensue from an opposite policy on the part of railway companies. The proprietors of the North Midland Railway, thinking that their affairs were not managed with a sufficient degree of economy, appointed a committee of inquiry to ascertain in how far reductions might be made in their expenditure. This committee proposed, and the proprietors sanctioned various reductions of a very sweeping nature, both in the number of the company's establishment of servants and in the amount of their wages. These reductions were carried to such an extent, that six of the directors, rather than sanction them, resigned their seats at the board, which were filled by as many members of the committee of inquiry. This change in the direction was immediately followed by the resignation of the whole of the enginemen and firemen on the line, who would not submit to the reduced scale of wages enforced by the new board. An entirely new set of enginemen and firemen were engaged in the course of a few days; and these strong measures were persevered in, in the face of a remonstrance addressed to the company by the Board of Trade. Not more than a few days elapsed, however, before the legitimate consequences ensued. A fatal accident happened at the Barnsley station, by the running of one train into another. The Inspector-general was immediately sent to the scene of disaster by the Board of Trade, and the following are some of the facts brought to light by his inquiries:—

> "On the whole, twenty-eight new enginemen were engaged by the North Midland Railway Company in the space of three weeks, of whom eighteen were engaged, in the first instance, to supply the places of the former enginemen, who resigned in a body. Of these eighteen men the Company were obliged to discharge no fewer than ten, after a day's trial, on account of incompetence or misconduct, after having in several instances occasioned accidents. So far from having produced unexceptionable characters, at least six of the new men were discharged servants from other Companies; one having been twice dismissed by the Croydon Company for general misconduct, and running his engine through a gate; and again, by the Manchester and Leeds Company, for intoxication while on duty; a second, by the Manchester and Leeds Company, for running his engine, contrary to orders, along the wrong line of rails; a third, by two different Companies, for insolence; a fourth, for causing an accident by carelessness, under suspicion of being drunk at the time; a fifth, for causing an accident by disobeying orders; and a sixth had left his situation in consequence of complaints against him for not keeping proper time with his train."

It is added, in a note,—

> "We have subsequently ascertained that in addition to the above, the engine-driver who occasioned the accident at the Barnsley Station, had been twice dismissed between the time of his leaving his situation as fireman on the North Midland Railway on the 14th of August, 1841, and being again engaged as an engineman on the 25th of December last, viz., by the London and South-Western Railway Company, by whom he had been employed as an engine-cleaner, for neglect of duty; and again by the Great Western Railway Company, by whom he had been employed in a similar capacity, for getting drunk and quarrelling with the other men."

Few impartial persons, we think, will deny that the conduct of the North Midland Railway Company, throughout the whole of this transaction, deserves the severest reprobation. It was neither more nor less than endangering the lives of thousands of unsuspecting persons, for the paltry purpose of enabling the company to pocket a very few pounds more dividend,—partly, perhaps, for the still more indefensible purpose of enabling the new directors to complete their supposed triumph by defeating the opposition of the engine-drivers, as well as that they had already overcome in higher quarters. It is alleged, we are aware, by these directors, in a letter to the Board of Trade, that, in consequence of the combined turn-out of the engine-drivers, they had only the choice of exposing the public to the danger incident to the employment of new servants, or to the still greater risks that would have ensued from the destruction of discipline necessarily attending an unconditional concession to the demands of the enginemen. Even admitting that the latter evil was the greater of the two, we are still clearly of opinion that the directors had themselves entirely to blame for being forced into either. We would by no means deny the right of the railway company to make such reductions as may be found necessary, and, at the same time, compatible with the efficiency of their establishment; neither do we pretend to judge whether the reductions in question were or were not justifiable on these grounds: but, supposing them to have been in the highest degree just, they ought to have been carried into effect with a reasonable degree of caution, and with a larger allowance of time and conciliation.

The present Report bears evidence that this department of the Board of Trade has conferred important benefits on the railway companies, as well as on the public interests. This it has been enabled to do by virtue of additional powers vested in it last year by Parliament, by which it is authorised to act as a mediator and arbiter between different companies in case of disagreement about the mutual rights of each on parts of their lines common to both. In the case of the Grand Junction and Manchester and Birmingham

Companies, the mediation of the Board of Trade has already had the effect of obviating much ruinous litigation, and preventing the most unseemly demonstrations of mutual animosity; but into the details of this and many other parts of the Report, our limits do not permit us to enter.

The appendices are much more voluminous than the Report itself,—the Report occupying only 22 pages of the entire volume; but, in consequence of the publication of the Report having taken place so late in the month, we have not been able to examine these miscellaneous documents as fully as we could wish. We shall, however, notice in our next Number any parts of them that, on farther examination, we think worthy the attention of our readers.

ART. XII.—METROPOLITAN IMPROVEMENTS.—SEWERS.

WONDERFUL as the sewerage of London undoubtedly is, it is still far from having arrived at that degree of perfection which is indispensable to the health and comfort of the inhabitants of so crowded a place. It is vastly inferior to the sewerage of ancient Rome, both in extent and completeness: in the latter, all deposit was obviated by the floods of water perpetually passing through them; whereas, in the London sewers a great deposit in many cases take place, which can only be got rid of by opening the sewer at the top, and carting away its disgusting contents. A radical reform appears to be requisite in the whole economy of our sewerage; but before indicating what that reform should be, we will present our readers with a few practical remarks upon some of the evils complained of by Mr. Roe, the surveyor of sewers to the Holborn and Finsbury division:—

"In the Holborn and Finsbury divisions there are about 98½ miles of covered sewers for house drainage, exclusive of several miles in length built by individuals, previous to the present regulations being made; there is also about 18½ miles of sewerage for the surface drainage, and about 10 miles of open sewers.

"In a large proportion of the covered sewers, from various causes, accumulations of foul deposit obtain. These accumulations existing beneath the streets in a state of ferment for many years, were a cause of much disagreeable and unhealthy effluvia, and were a further annoyance to the public by choking up the private drains when they attained to any considerable quantity. The remedy for the evil, when complained of, was only to be had by raising the noisome substance in pails to the level of the street, and carting it away; a process which, in itself, was subject to many manifest objections, and made the breaking up of the pavement and roads, and the consequent obstruction of public thoroughfares, unavoidable.

"On a general examination into the causes of deposit, one thing that arrested attention was this, viz. that in sewers of the same form and with the same fall or inclination, a different degree of accumulation was found to exist. In some instances this difference was occasioned by the common run of water being greater in quantity in one sewer than another. In other sewers the current of water coming in, where old sewers improperly met at right angles, was found to cause, at the junction of the two streams, an obstruction to the flow along the main line, and here deposit accumulated; and where the collateral sewers were connected with the main line at right angles and at different levels, the obstruction was still greater; for example, in one instance where the collateral sewer was 3 feet above the level of the main line, a deposit was formed of a foot in depth, extending in a shoal up the stream to the length of several hundred feet from the point of junction, while below that point the sewer was perfectly clear. It was also observed, that where a gully neck delivered the surface water of the street or road into the sewer through the crown of the arch, an obstruction was caused in the sewer, and deposit accumulated largely on the up-stream side. The whole of these obstructions tended to lessen the capacity of the main line of sewer. The inequality of the bottom of many sewers, and the little fall in others, were causes of accumulation of deposit, and the common run of water in many sewers was found to be insufficient to carry the deposit away.

"To remove accumulations from the sewers in a way less offensive than the prevalent mode, to construct the sewers on such principles as were likely to lessen the cause of the formation of deposit, became subjects of consideration. Levels were taken through the Holborn and Finsbury divisions, to ascertain the practicability and expense of remodelling the sewers and rebuilding them at the lowest level which the outlets would afford; but is was found that the level was such as would not give that fall to the sewers as would secure the passing off of the foul matter with the common run of water, and that the utmost that could be obtained would be the natural cleansing of one-half of the sewers; while the remaining portion would still require artificial aid. The cost of lowering the sewers to obtain this partial relief would be, as before stated, nearly a quarter of a million sterling."

The great expense consequent upon the renewal of the sewerage having operated as a barrier to that project, a method of mitigating the evils by "flushing," or scouring, was resorted to. This plan is a very old one; as applied to sewers in Eton college, for example, it has been in use for 400 years. On the larger scale, the principle has been applied to the removal of bars of rivers, and deposits of sand, as in the case of Dover harbour. We must, however, let Mr. Roe explain his application for himself.

"There being a current of water of greater or less quantity in all sewers, in some constant, in others periodical, the idea presented itself of turning this ordinary current to advantage in preventing the accumulation of deposit; and to do so, the use of dams at certain distances asunder, to collect heads of water, was thought of.

"A series of experiments was commenced in order to ascertain what velocity could be obtained, and how far such flushes of water would maintain velocity sufficient for the purpose required. These experiments were made with board dams fixed in the sewers, and the results led to the conviction that the deposit might be removed at less expense by this than by the prevalent method. In making experiments it was observed that the effect was the greatest when the dam was removed the quickest. Sufficient data having been acquired, the matter was laid before you, and a great number of openings were directed by the Board to be made in various sewers having different degrees of accumulation, that you might personally see the effect of the plan on an extended scale. The result proving satisfactory, you encouraged the idea, and several of your body made very valuable suggestions upon the various methods of application which were brought before you; and a report was directed to be made upon the system of flushing, and another suggested improvements which you were pleased to adopt. In that report it was stated that the average yearly cost of cleansing was about 900*l.* per annum. To this there would in future have to be added the cost of cleansing such sewers as had not then been cleansed, but in which deposit was accumulating, and in time would need removal. An example of this class of sewers may be seen in the extensive sewerage on the Whiskin estate, Clerkenwell. These sewers have been built about twenty years, and have not required cleansing until this winter. The different degrees of accumulation in these sewers show also many of the causes of accumulation where sewers are well built and have a good fall in them. For instance, the sewer in Meredith-street having a constant flow of water turned through it from St. John-street-road is kept free from deposit, whilst in the sewers in Whiskin-street, Skinner street, Coburg-street, and the upper part of Glo'ster-street, the common run of water being too small to keep them clear, deposit accumulates; and in the lower part of Glo'ster-street, where the junction with Meredith-street was at right angles, the deposit had accumulated to nearly twice the depth that it had done in the other sewers. Of this class of sewers that would gradually come under the necessity of cleansing, there is about 97,498 feet, which, estimated at the quantity of deposit contained in the above named sewers, would, by the old method of cleansing, involve an expense of 244*l.* per annum, in addition to the sum before named."

"In the Report before named, it was stated that if the average sum which the cleansing then cost was applied for seven years, and the cleansing done by flushing, the apparatus and side entrances might be fixed to the sewers without any extra charge whatever, and the public would, at the end of that period, derive the benefit of a saving of nearly 800*l.* per annum, besides securing, during those years and for the future, a saving of 300*l.* per annum in the item of cleansing, which the Commissioners had effected under their then existing contracts. The flushing system being adopted by you, the method of carrying it out was ordered to be as follows, viz., that when a sewer was complained of and required cleansing, the foul deposit should be flushed away, and apparatus fixed to enable it to be kept free from accumulations of deposit in future. The result to this time is as follows. Since the commencement of the system of flushing, the foul deposit has been washed away from about 16 miles in length of old sewers, on which have been placed 59 side entrances and 67 flushing gates. After deducting from the cost of removing this deposit by the old method, the expense of all the side entrances and flushing gates, there remains a saving of 445*l.* 13*s.* 6*d.*, and the side entrances and apparatus are furnished for future use. These sewers are about 2-7ths of those that appear to have deposit accumulated in them; and 2-7ths of the average annual cost of cleansing by the old method would be 326*l.* 17*s.* The annual cost for men to work these gates is 106*l.*, forming a saving of 220*l.* per annum on these 2-7ths of the sewers. The total cost of flushing apparatus to these 2-7ths of the length of the sewers has been 434*l.*; thus whenever that apparatus should require renewing, the amount of two years' saving will renew the whole. It is not likely they will require renewing for between 30 and 40 years, if then. It is very probable that the interest of the saving will keep the apparatus renewed. There is also the saving to individuals of the cost of cleansing private drains, which, by the system of flushing, can never become choked by accumulations in the sewers as heretofore; and when it is considered that many sewers required cleansing every fifth year, the amount of expense and annoyance must have been considerable. Another benefit has been the avoidance of breaking up the pavement and roads, the cost of replacing which for holes that must have been made to cleanse the sewers that have been flushed, would have been 370*l.* The raising large quantities of foul deposit to the surface, to the annoyance of the inhabitants and passengers, has been prevented. And the side entrances and flushing where they occur have afforded facilities for the men to rake the deposit from old gullyholes into the sewers, from whence it is washed away, thus preventing the breaking up the paving round the gullyholes, and a saving in the article of cartage of the deposit. In one year and a half the saving from this cause in the amount paid for reinstating paving round the gullyholes alone has been 101*l.* 8*s.* 4*d.* A misconception appears to exist that each flushing gate requires a man to look after it; it may not therefore be irrelevant in this place to state that one man will be able to look after and manage all the flushing gates that may be placed in a district containing 15 miles of sewer.

"With respect to private drains, the flushing gates are placed on such a principle that, if the whole of them were shut for twelve months together, the houses draining into the sewers would not be at all affected by the water in the sewers; but these gates are never shut except periodically to collect a head of water, and after the head is let off the gate is fastened back, so that no obstruction whatever is caused any where by the application of the system of flushing. At present, as above stated, the flushing gates are placed in such a manner that if kept shut for months together, the water would not enter the private drains; but the result of experiments made upon this point was such as induces the surveyor to state it as a matter worthy future consideration."

The remedy for these evils is, a more abundant supply of water, which may sweep away all deposit by the force of its current; and this amelioration is to be achieved only by an increase either in the power or number of our water companies. It is proposed that the contents of all the sewers should be received in great side-sewers on each side of the Thames, which would convey it away for the purpose of manure. In many places, with greatly inferior pretensions to skill in such matters than we possess, this is done with the happiest effect. In Tetuan, in Barbary, for example, the refuse from the sewers run to the gardens outside the walls, and those gardens produce the finest oranges, perhaps, in the world. In Edinburgh the plan has lately been adopted, as will appear by the following from the *Quarterly Review:*—

> "When Mr. Chadwick visited Edinburgh with Dr. Arnott, they were both, without metaphor, 'led by the nose' to a certain stream properly enough called 'the Foul Burn,' from having been the aged receptacle of most of the sinks, drains, sivers, &c., of Auld Reekie. For a considerable time the character of this burn was repellant; and, accordingly, avoided by poor as well as by rich, by young as well as by old, its contents flowed in mysterious solitude into the sea. Several years ago, however, some of the occupiers of the land in the immediate vicinity, instigated by self-interest, took the liberty of tapping this stream, in order to collect a portion of its contents into tanks for manure. The next step in the march of intellect was, by means of water, to irrigate the meadows from this source, in order to save the expense of cartage; and thus, by degrees, 300 acres of meadow land, chiefly in the neighbourhood of the palace of Holyrood, were fertilized from the contents of this common sewer; the result of which has been that some of these meadows are let at from 20*l.* to 30*l.* per acre; indeed, in the year 1838 some were let at 38*l.* per acre, and in 1826 at 57*l.* Her Majesty's Government, however, being justly of opinion that this process is prejudicial to the healthiness of Holyrood House, and having accordingly directed legal process for the trial of the right of irrigation, the defendants now plead that the invalidation of their claim would deprive the city of the milk and butter of 3,000 cows, and estimate the compensation which would be due to themselves at 150,000*l.*
>
> "About a quarter of a century ago we ourselves remember to have witnessed the process of a matrimonial alliance, such as we have described, between two parties, who, from the beginning of time, had always been shy enough of each other, namely, the very Foul Burn alluded to, and the Links or sand-hills on the sea-shore between Leith and Porto Bello. These hillocks, upon which nothing but a few stunted tufts of coarse grass had ever been seen to grow, and which, for ages, had been blown by the wind into a variety of fantastic forms, were one morning suddenly attacked by a band of workmen, who, with spades and shovels, were seen busily scattering the sand about them in all directions. '*Are ye daft?*' was the repeated exclamation of the Musselburgh fishwives, who, one after another, striding by with outstretched heads, swinging arms, and a creel full of cod on their inclined backs, could not contain their astonishment at seeing the dry region, which all their lives had been sterile, suddenly subjected to spade husbandry. Indeed, when the mass was levelled it was as barren and lifeless as the shingle of the sea; and continued so during the formation of a network of arteries and veins, which, in the form of drains, were imprinted over its surface. However, no sooner was this latter operation concluded, than —'*Oh whistle, and I'll come to you, my lad!*'—the produce of the Foul Burn, like Birnham Wood coming to Dunsinane, majestically made its appearance; in a few days the sand was verdant; and before the summer was over, it bore a dark-coloured, rank, luxuriant crop."

The value of this sort of manure may be judged of from the following:—

> "Mr. Chadwick states that, according to the scale of the value of that portion of the refuse of Edinburgh which has been appropriated to irrigation in the way described, the whole refuse of that city would produce an income of from 15,000*l.* to 20,000*l.* a year; while, according to the same scale of value, it appears that, in the city of London, refuse to the enormous value of nearly double what is now paid for the water of the metropolis is now thrown away, principally into the Thames, and partly into receptacles in the districts of the poor, where it accumulates until it is removed at a great expense. Where the levels are not convenient, Captain Vetch, of the Engineers, and other competent authorities, recommend that the contents of the sewers should be lifted by steam-power, as water is lifted in the drainage of the fens; and then be distributed in iron pipes, in the same way as water is injected into the metropolis by the water-companies. Mr. Chadwick adds, that the estimated expense of this mode of cleansing and removal, as in the case of the conveyance of water into London, would not amount to a tenth part of the cost of cartage; and to show the practicability of the principle of removing refuse by water, he cites the following case:—The West Middlesex Water Company had almost concluded a contract for removing, in the ordinary way, about an acre of silt, four feet deep, which, in the course of eight or ten years, had accumulated in their reservoir at Kensington, and accordingly 400*l.* was to be paid for this operation, which was to occupy three or four weeks. The bargain was all but sealed, when it was proposed by one of the officers that the silt should be mixed with water, stirred up, and in this liquid state washed away; and this operation was successfully effected in three or four days, at an expense of only 40*l.* or 50*l.*"

We cannot extend our extracts farther, and here dismiss this subject for the present.

To the Metropolitan Improvement Society the public is, we think, much indebted for the attention it has given to this and other inquiries; and we trust that at no distant period much amelioration will be the result of its very philanthropic labours.

ART. XIII.—ANATOMY OF THE STEAM ENGINE. No. 3.

PLATE VIII. contains some of the details of the engines of the "Don Juan," the section of which we gave in our first Number. We shall continue to give a plate of these details in every Number, until the whole are given, so that the engines might be made from the plates we furnish. To practical engineers, details of this kind will be far more acceptable, we believe, than general views of a great variety of engines; and we shall by this means be enabled to illustrate the advantages and defects of particular modes of construction much more completely than would be possible by any other method.

Fig. 1 is an elevation of the sole plate and condenser. The condenser is cast on the sole plate, and sockets are also cast on for the reception of the bottom of the air-pump and bottom of the slide-valve. This mode of attaching the air-pump and slide-valve to the sole plate by a faucet joint is not a common one, the junction being usually effected by means of flanges; but we think the plan of a faucet is the best for fixing the air-pump to the sole plate: it is not so, however, in our opinion, in the case of the valve-casing, inasmuch as the faucet cannot go all round, on account of the interruption of the cylinder. The air-pump was fixed into the faucet by means of steel keys, and the faucet was then filled with rust. The joint at the bottom of the valve-casing was also a rust one: on the circular part of the casing the joint was, of course, between the exterior of the casing and the inner side of the semicircular coming; and, at the straight part, the joint was between the bottom of the cylinder and the upper surface of the sole plate. It is obviously necessary, in order that this joint may remain tight, that there should not be the least relative motion between the cylinder and sole plate;—in other words, that the cylinder should be secured to the sole plate so firmly that there should not be the least visible motion between them. In this point the engines of the "Don Juan" were defective. They were at first attached to the sole plate only by the holding-down bolts—the same bolts which go through the bottom of the ship; and however strong these bolts may be, they are not to be depended on for keeping the cylinder without any movement, inasmuch as, from the working of the ship, the compression of the wood, and other causes, they will generally, however tightly screwed up at first, get slack in a little time; and, when in that state, the joint may be broken. To obviate the tendency of the cylinder to move sideways, keys are introduced in the fitting-strip, sunk partly into the sole plate, and partly into the cylinder bottom, as appears most conspicuously by the ground plan; but the right way is to bolt the cylinder to the sole plate by a multitude of bolts, as in the case of the cylinder cover. Opposite to the straight part of the casing-joint a small hole is left at the bottom of the coming, through which the rust used in making the straight joint is caulked. The main centre is fixed into its place by six steel keys, and the outer edge of the boss through which it passes is encircled by a malleable iron hoop, so as to strengthen the boss against the pressure of the keys. This hoop is of course put on hot. The hot-well is attached to the top of the condenser by a faucet, and at each side of the top two snugs are cast on, against which the part of the framing projecting from the diagonal stay to the condenser top is keyed. At each corner of the condenser bosses are cast on for the reception of the holding-down bolts, which keep down the main centre.

Fig. 2 is a section of the condenser and sole-plate, showing the thickness of metal and arrangement of the internal passages. The steam escapes from the lower cylinder port, at the bottom of the valve-casing, into the passage, the depth of which is marked 1 foot, and ascends up towards the injection rose through the passage marked 7½ inches. From the upper cylinder port the steam descends through the hole marked 1 foot 1½ inches. The purpose of the diaphragm is manifestly to prevent the water from flowing from the condenser into the lower cylinder port.

The main centre is inclosed by a pipe, which, in this figure, we observe is not cross-lined, as it should be. Above and below this pipe three strong feathers are cast on the condenser sides, the depth of which is shown in fig. 5, and immediately beneath the condenser top four oblong bosses appear, the object of which is to enable the framing to be attached to the condenser top by bolts, without making holes through it, which, with the working of the framing, would be apt to leak. The faucet joints, we may observe, for attaching the air-pump, &c. to the sole plate, were made a little conical, so that the air-pump could not be forced out of its place by any upward pressure without first compressing the rust, or breaking off the socket.

Fig. 3 is a ground plan of the sole plate and condenser, and fig. 4 a horizontal section. The main centre, it will be observed, is tapped at the end by a bolt, the function of which is to hold on the side lever, and prevent lateral jolting.

Fig. 5 is an end view and transverse section of the same parts, which sufficiently explain themselves. The bolt-holes shown at the upper part are for the attachment of the nozzle of the air-pump.

Fig. 6 is the paddle-shaft, with crank-pin and section of the crank. The bosses for the attachment of the paddle centres are square, which is, we think, the best form, as admitting of firmer keying. This shaft is, upon the whole, well proportioned; but the journal is, we think, rather short, and the fillets at the corners of the bearings are too small. When these fillets are small, the shaft will soon acquire play end-ways, and cannot be tightened up in that direction; whereas the opposite is the case when the fillets are large.

Fig. 7 is the intermediate shaft, and fig. 8 the crank. The mode of attaching the crank to the shaft is, it will be observed, by means of three round keys. This plan we do not like. The two outer keys weaken the crank-eye very considerably, and the round key at the web is liable, if the crank becomes loose, to be burst up into fibres, like a faggot of wood, which will work out gradually. We prefer the plan of using one large square key, sunk half into the shaft, and half into the web of the crank. This plan neither weakens the crank-eye, nor involves the likelihood of the key being split up, should the crank become loose. It is of course taken for granted, in these remarks, that the crank is put on hot, as is now, we believe, the universal practice.

The mode of fixing in the crank-pin employed in the "Don Juan" is a good, and not by any means a common one. It consists in the application of a strong washer over the crank-eye, with a hole in the centre, through which a stout bolt passes tapped into the pin below. The washer is indented a little into the crank-eye, so as to obviate any tendency to move laterally. This plan we know, from our own experience, to be a most effectual one: it is unattended with any more trouble than if the pin were riveted in, and it admits of the pin being taken out, by merely unscrewing this bolt. The end of the pin inserted in the loose eye is of course made spheroidal, so as to permit the outer end of the shaft to drop a little, without breaking the pin. The pin is steeled on both sides of this spheroidal part, and bears against two dovetail steel plates. The plate situated on the *backing* side was, in the case of the "Don Juan," tightened by means of a screw.

The crank, it will be observed, is of rather an unusual shape; the intention of the makers being, that the web should be capable of resisting the twist occasioned by the overhang of the crank-pin more effectually than in the case of cranks whose shape is regulated by the supposition that the crank-pin does not overhang at all. There is more plausibility than soundness in this reasoning; the fact being, that the strength given for the single purpose of overcoming the leverage is more than sufficient to withstand the twist.

Figs. 9 and 10 are a section and end view of the hot-well, and figs. 11 and 12 ground plan and horizontal section of the same part. The left hand portion of this, as shown in fig. 9, is in reality the eduction passage, the opening into which from the valve-casing, appears in fig. 10. The circular and elliptical figures which appear in fig. 11, are the faucet comings for the hot-well air vessel, and the cylinder and valve-casing, of a small engine situated in that part for giving motion to the valve by which the large engine is governed, so that the operation of starting the large engine might be accomplished by merely moving the valve of the small one. The two rectangular holes shown in the same figure are spaces in which the back balance-weights of the large engine valve move. The small chest attached to the side of the hot-well, and appearing in figs. 10 and 12, is for the purpose of enabling the feed-pump to draw its supply from the hot-well, and return its excess again into the hot-well through a loaded valve. The chest, therefore, contains all the valves the feed-pump possesses; and the situation in which it is placed has the effect both of saving pipe and making the valves more accessible.

Plate IX. exhibits the details of Bury's locomotive engine, of which we gave the section, &c. last month.

Description of Plate IX.

This plate shows the details of the framing of the merchandize-engine. The letters correspond in all the figures.

a a. Two straps, firmly riveted on each side to the frame, passing beneath and half round the cylinders, which are connected to them by being accurately fitted into snugs cast on the cylinders, and riveted to them.
b. The crank-axle.
c. The axle of the front wheels.
d. The springs.
e. The transverse shaft for the steadying-pieces of the guides.
f. The bolt-holes for fixing the force-pumps on the frame.
g. The buffer-bar.
h. The bolts for fixing the buffer-bar to the frame.
i. The bolt-holes for the suspension-rods of the springs.
k. The cotter-joints connecting the lower with the upper part of the frame.
l & *m.* Holes for receiving the draw-pin for connecting the tender with the engine.
n. The holes for fixing the plate to the frame.
p. The bracket for connecting the frame with the fire-box.
q. The bracket connecting the frame with the body of the boiler.
r. The strap connecting the lower part of the frame with the bottom of the fire-box, into which it is dovetailed and bolted.

We subjoin the following remarks by Mr. Bury:—

> "The most essential requisites in a locomotive boiler are, a great extent of heating surface in a small compass, and the arrangement of that surface so as to cause and promote a rapid circulation of the water. These principles have been kept in view in the disposition of the tubes and the shape of the fire-box.
>
> "The central tubes and the centre of the fire-box are nearest to the surface of the water, which is consequently hottest and lightest above those parts, and towards them the particles of water or globules of steam will rush; the outer tubes and sides of the fire-box being lower, and consequently cooler, establish a return current of the colder particles of water from the centre towards the sides and bottom of the boiler.
>
> "This arrangement of the upper row of tubes has also the advantage of preventing any of them from being uncovered when the engine is travelling on sharp curves, where the centrifugal force throws the water to one side of the boiler.
>
> "The fire-box is cylindrical, with its back flattened to receive the ends of the tubes: its top is a sphere merging into a cylinder or elongated cone, and all the curves are such as to enable the plates to resist the pressure of the steam without the assistance of ribs or stays, which so materially prevent the circulation of the water over square fire-boxes. The cylindrical-shaped fire-box possesses a great superiority over a square one, inasmuch as the corners, in which the combustion is always languid, are avoided.
>
> "A lead-plug is placed at the culminant point of the dome-shaped top, and will therefore melt before any other part of the fire-box is left dry: in a fire-box with a flat top this would only occur when the whole was dry and probably injured.
>
> "The fire-box is made of wrought iron three-eighths of an inch thick, except the tube plate, which is half an inch thick. The joints are welded wherever they are in contact with the burning fuel, as a riveted joint, from its presenting a double thickness of metal, will not long resist the intense heat to which it is exposed. If it were made of copper instead of iron, the thickness of the metal must be greater, and the weight would be increased; and it will be seen, in a comparison of the engines having four and six wheels, that the lightness of the iron fire-box is a point of considerable importance.
>
> "It is practically found that the passenger engine consumes 75, and the merchandize engine 85 cubic feet of water per hour. This quantity is greater than that calculated from the steam's elasticity in the cylinders, and from the number of cylinders filled, and emptied, at the respective mean velocity of 30 miles per hour for the passenger, and 25 miles per hour for the merchandize engine. The difference is owing to the escape of steam through the safety-valves, and to the occasional slipping of the wheels on the rails when the load is heavy.
>
> "Hence the superficial heating surface, to evaporate one cubic foot of water in an hour, will be in the boiler of the passenger engine 5·6 square feet, and in the boiler of the merchandize engine 6· square feet of heated surface. This is nearly double the effect produced in stationary boilers, and yet the result is obtained without any considerable sacrifice of fuel; for, including all the coke which is wasted throughout the year, when the fires are drawn or lighted, and that which is used in the workshops, &c., the merchandize engines only consume 12lbs., and the passenger engines 15lbs. of coke per cubic foot of water evaporated.
>
> "Taken together, these results are superior to anything that has been obtained from long trials of any other description of locomotive boiler."

Art. XIV.—PHYSIOLOGY OF THE STEAM ENGINE. No. 3.

Parallel Motion.—Plate X.

The forms of parallel motion which have been used are so various, that we shall not attempt to enumerate the whole. In what follows, however, we shall treat of those varieties that have been most commonly adopted in land or marine engines; and in doing so, it will be our object both to explain their principles of action, and give practical rules for calculating the lengths of the various parts in every assignable case.

The forms of parallel motion that we shall discuss are four in number; one adapted to land engines, and represented in fig. 3; the others used for marine engines, and represented in figs. 4, 5, 6. It will be found that all these different arrangements act on the same fundamental principle; and therefore, before going farther, we shall proceed to explain it. Let G C and H F be two levers moving round centres at C and H, and connected together by the rod or link G F. We shall suppose that G C represents the beam of an engine standing in a horizontal position at half stroke. The rod H F represents the radius bar of the parallel motion, and at half stroke it must be horizontal, or parallel to G C. In the present case we shall suppose it to be equal to G C in length. If the beam be made to turn on its centre, so as to cause G to move towards G′, the point E in the middle of the link G F will move upwards nearly in a perpendicular line R′ S′, bisecting the versine D K. This will be evident from the following considerations:—As the point G revolves in the circle G G′, the point F revolves with nearly equal rapidity in the equal circle F F′. Both points, it is evident, will, when the motion commences, approach nearer the line R′ S′; and since the circles F F′ and G G′ are of equal radius, and the arcs described are nearly equal, the point F will move towards the line R′ S′ at the same rate as the point G. Both points will cross that line at the same time, and both will respectively reach F′ and G′ simultaneously. F′ L will evidently be equal to G′ K. Now, if the points F and G are always on opposite sides of the line R′ S′, and at the same distance from it, it is clear that the centre of the link E must always be in it; and, accordingly, this would be mathematically true, if G F, by changing its inclination to the perpendicular, did not alter the perpendicular distance between the points F and G. This, however, it does; and as the points G and F ascend the link, G F gets more nearly perpendicular; thus increasing the perpendicular distance between G and F; in consequence of which, at the point where F crosses the perpendicular R′ S′, it has not described quite so large an arc as the point G; or, when F is crossing R′ S′, the point G is still at a small distance from it. This renders the motion of the point E not perfectly coincident with the perpendicular line; but the shortening of the perpendicular distance between G and F, by the vibration of the link G F, when the length of the link is considerable, and the stroke of the beam not greater, in proportion to its length, than usually obtains in steam engines, is so exceedingly small as to be unworthy of the slightest consideration in practice. At either end of the stroke the link G F will have the same inclination as at half stroke, and the point E will therefore be exactly in the perpendicular line R′ S′ at both these points. Its motion will be represented by the curved line R′ O S′, fig. 7, cutting the perpendicular at R′, O, and S′, and deviating from it by an almost imperceptible quantity at X and W. From the fact, however, of a deviation being caused by the vibration of the link G F, we may infer the propriety of making that vibration as small as possible: and one very obvious precaution to be taken on this ground is, so to place the levers H F and G C at half stroke, that the line R′ S′ shall bisect both their versines F L and D K. By this means the link G F vibrates equally on both sides of the perpendicular, and, consequently, never deviates from it so much as if it were to vibrate in one direction during the motion of G to G′. It is not always convenient to have the radius bar H F of the same length as the beam G C: it is sometimes longer, and sometimes shorter. In fig. 2 it is represented one half the length of G C. In this case, H F being shorter in proportion to the arc F″ F F′, which it describes, the versine F L is of course greater than in the former case. The lever should still be so placed, however, that the line R′ S′ bisects its versine L F. Owing to the inequality of the versines L F and G K, the middle point of the link G F can no longer move in the line R′ S′; but there is a point, E, nearer the end of the link G, that does move nearly in this line. This point is so situated, that G E : E F : : F H : G C. For, within the limits usually assigned to the arcs described by engine-beams,* the versines are nearly in the inverse ratio of the radii; that is to say, vers L F : vers D K : : G C : H F. Now the vibrations of the points F and G on each side of the line R′ S′ are equal to half the versed sines of the arcs described by these points respectively; that is, to F *f* and G *g*. Hence, F *f* : G *g* : : G C : H F, and by similar triangles F *f* : G *g* : : F E : G E; hence, F E : G E : : G C : H F.

As this proportion holds true at any part of the stroke, it proves that the point E, which divides the link in this proportion, moves in the perpendicular line R S′. When, therefore, the lengths of the levers are given, it is easy to find the point E; but in practice it generally happens (as will be shown subsequently) that the point E is fixed; and we have to find H F. This will be done from this proportion, $\mathrm{F\,E : E\,G :: G\,C : H\,F} = \dfrac{\mathrm{G\,C \cdot E\,G}}{\mathrm{F\,E}}$ . . . . . (A).

This proportion is founded on the assumption that the versed sines of the beam and radius bar are inversely as the radii. This, though nearly true, is not exactly so. The versed sines of the smaller radii increase in a greater proportion than the inverse ratio of the radii. The consequence of this is, that the point E in the link G F will be moved too much towards H, and will deviate from the perpendicular in that direction at each end of the stroke. In small engines, and when H F is nearly equal to G C, this deviation will be so small as scarcely to be worthy of notice; but in large engines, and when there is a considerable difference between the lengths of the radius rod and beam, it will be of some consequence. From what has already been said it will be observed that the deviation is all on one side of the perpendicular; so that the curve described by the point E will be of the shape shown in fig. 8. By making a small addition to the length of the radius bar, we can make the deviation take place equally on each side of the perpendicular. We can add so much to its length as to make the point E move towards H too slowly at half stroke; or, in other words, deviate towards C till the beam has got about quarter stroke from the horizontal position, when the point E will cross the perpendicular, and deviate to an equal amount towards H. The curve described by E will then be of the shape shown in fig. 9, where the deviations at *m*, *n*, *o*, *p*, are all equal, and only half the deviation at *r* and *s* in the last figure.† To facilitate the making of this correction in the length of the radius bar, we give the following table of the amounts to be added to its length for the various proportions that may obtain between it and the beam C G. It is to be observed, too, that when the radius bar H F is longer than the beam G C, these amounts are to be *subtracted* from its length.

TABLE (A.)

This column gives $\frac{\mathrm{F\,H}}{\mathrm{C\,G}}$ when C G is the greater, and $\frac{\mathrm{C\,G}}{\mathrm{F\,H}}$ when F H is the greater.	Correction to be added to or subtracted from the calculated length of the radius bar, in decimal parts of its calculated length.
1·0	0
·9	·0034
·8	·0075
·7	·0163
·6	·0270
·5	·0452
·4	·0817

It will be observed that the greater the difference between the lengths of the radius bar and beam, the greater is the amount of the correction to be made. As an example of the use of the table, suppose we have the length of the beam C G = 38 inches, and that the radius bar has been found by proportion (A) to be 15½ inches; 15½ ÷ 38 is nearly ·4 : we shall therefore get for the corrected length of the radius bar 15½ + ·0817 × 38 = 16·76 inches. The application of this correction to the length of the radius bar, will in all cases diminish the amount of the deviation from the perpendicular by one half; but it should be borne in mind that the parallel motion will work most accurately when the radius bar and beam C G are of the same length: and they should therefore be kept as nearly equal as circumstances will permit.

The simple arrangement of two levers connected by a link, which we have now described, is sometimes used as a parallel motion; but additional rods and connecting links are generally superadded, which render the application of the principle more convenient in practice. Fig. 3 represents the parallel motion in most general use for land engines; and fig. 4, a similar one adapted for marine side-lever engines. The general arrangement in both of these is the same, except that the marine engine motion has the reverse side uppermost. We have marked all the corresponding parts in the two figures with the same letters, so that what we have to say of the one will refer equally to the other. In land engines, the radius bar H F is generally either equal to or longer than G C, the part of the beam which works it; while, in the marine engine motion, the radius bar is usually shorter than the part of the beam that gives it motion. This difference is shown in the figures. Referring now to figs. 3 and 4, we shall explain the method of applying the principles we have already described to the calculation of the proportions of the several parts. D C is the beam or side lever moving on the centre C; H F, the radius bar moving on the centre H, and connected with the beam by the rod F G. D P is another rod equal in length to G F; and P F is a rod equal in length to D G. The three rods, therefore, D P, P F, and F G, with the part D G of the beam, form a parallelogram; and the piston-rod is attached to the point P, which, at half stroke, is in the perpendicular line R S, bisecting the versed sine D K. When the engine is put in motion, this point P will move nearly in the perpendicular line R S. For, suppose the beam to be moved upwards into the position D′ C, the point P will then be in the position P′; and the positions of the various other points are denoted by corresponding accented letters. Join C P and C P′, and also E E′, and we will have, by similar triangles, P E : E C : : D G : G C : : D′ G′ : G′ C, and P′ E′ : E′ C : : D′ G . G′ C; hence, P E : E C : : P′ E′ : E′ C.

Therefore, (Euclid vi. 2.) P P′ is parallel to E E′. Let the length of F H be made such, that $\mathrm{H\,F} = \dfrac{\mathrm{G\,C + E\,G}}{\mathrm{F\,E}}$ and by equation A, the point E will move in a perpendicular line; but P P′ having been proved to be parallel to the line E E′ in which E moves, the point P must also move in a perpendicular line. Again, referring to equation (A), we have

E F : E G : : G C : H F, but by similar triangles
E F : E G : : F P : G C : : D G : G C

$$\text{hence, } \mathrm{D\,G : G\,C :: G\,C : H\,F} = \frac{\mathrm{G\,C^2}}{\mathrm{D\,G}} \ldots\ldots\ldots\ldots \text{(B)}$$

This equation will give us the length of the radius bar H F, when the length of C G is determined. In land engines the air pump is generally wrought from the point E, and the centre G is fixed so as to be most convenient for that purpose. Formula (B), is therefore very useful for determining the proper length of the radius rod in such cases. In marine engines, however, the position of the centre H of the radius bar is generally fixed from other considerations, and it becomes necessary to find at what point the centre G should be placed, so as to make P move in a perpendicular line.

To enable us to determine this,
Let H F + G C = *a* = the horizontal distance of the centre* H, from the

---

* The beam of an engine is usually made at least three times the length of the stroke; so that the sine of the angle which it makes with the horizontal line at the extreme of its stroke, is equal to ⅓ of the radius. The angle whose sine is ⅓ of the radius, is 19° 28′.

† Let G C = r G′ G″ = s, and arc G″ G G′ = ϕ; then G K = vers ϕ;

$$\text{but by (Euclid, III. 35), } \mathrm{G\,K\,(2\,G\,C - G\,K)} = (\tfrac{1}{2}\,\mathrm{G'\,G^2})^2$$

$$\therefore \operatorname{vers}\phi\,(2r - \operatorname{vers}\phi = \tfrac{1}{4}s^2 \quad \therefore 2r\operatorname{vers}\phi = \tfrac{1}{4}s^2 + \operatorname{vers}^2\phi$$

$$\therefore r = \frac{\tfrac{1}{4}s^2 + \operatorname{vers}^2\phi}{2\operatorname{vers}\phi} = \frac{\tfrac{1}{8}s^2 + \tfrac{1}{2}\operatorname{vers}^2\phi}{\operatorname{vers}\phi};\ \text{or, } r = \frac{\tfrac{1}{8}s^2}{\operatorname{vers}\phi} + \tfrac{1}{2}\operatorname{vers}\phi$$

$\tfrac{1}{8}s^2$ being a constant quantity, this equation shows that the radii are inversely as the versed sines only when ½ vers ϕ is indefinitely small in comparison of r; and that, by any increase of the versed sine, ($\tfrac{1}{4}s^2$ being always constant) the radius diminishes in a less ratio than the versed sine increases, and *vice versa*. Of course the converse of this is true also; that, if the radius be diminished, the versed sine increases in a greater ratio, and *vice versa*.

When the beam is just leaving the horizontal position, the versed sine is indefinitely small in comparison of the radius; and therefore, at this point, the versed sines of the beam and radius bar will be inversely as the radii; and H F, as determined by equation (A), will be correct for this part of the stroke. At either end of the stroke, however, it ought to be equal to $\dfrac{\text{versed sine D K}\cdot\text{G C}}{\text{versed sine F L}}$. Now, as it cannot have both these values, the nearest approach to accuracy we can make is, to make its length intermediate between these two. The corrections in the table are computed on this principle.

* If a perpendicular H M be let fall from H on D C, M C will be the horizontal distance of the centre H, from the main centre; and since F G is parallel to P D, it is evident that F H + G C = *a* = M C + D N.

main centre, plus half the versed sine of the arc, described by the extremity D of the beam

$$D\,G + G\,C \text{ or, } D\,C = b$$

$$\text{then, } G\,C = a - H\,F \mathrel{.\,\dot{}\,.} D\,G = b + H\,F - a$$

$$\text{hence, (B)} \;.\;\;.\; H\,F = \frac{(a - H\,F)^2}{b + H\,F - a} = \frac{a^2 + H\,F^2 - 2\,a \cdot H\,F}{b + H\,F - a}$$

$$\therefore H\,F^2 + H\,F\,(b - a) = a^2 + H\,F^2 - 2\,a \cdot H\,F$$

$$\left.\begin{aligned} \therefore H\,F &= \frac{a^2}{b + a} \\ \text{or, } H\,F &= \frac{(G\,F + G\,C)^2}{G\,F + G\,C + D\,C} \end{aligned}\right\} \;.\;\;.\;\;.\;\;.\;(C)$$

This equation will give us the length of H F; and to get G C, we have

$$G\,C = a - H\,F \ldots\ldots (C')$$

These three equations, therefore, (B), (C), and (C′) enable us to calculate the proportions of this form of parallel motion in all circumstances.

In figs. 5 and 6, two other forms of parallel motion in common use for marine engines are represented. In fig. 5, the radius bar, instead of being connected as formerly to the crosshead, is connected by the rod F Q to the side rod by a pin at Q. F Q is made equal, and parallel to G D; and F G equal, and parallel to Q D. In fig. 6, the centre H of the radius bar, is placed much farther from the main centre. It may be on either side of the piston rod, as is found most convenient. In this motion, too, the end F of the radius bar is connected by a pin to the upright rod G V. The rod G V is made equal, and parallel to the side rod D P, and the rod P V is made equal and parallel to D G.

To enable us to investigate the method of calculating the lengths of the parts in these motions, join as before C P, and C P′, and from the point T where C P cuts F Q in fig. 5, or H F in fig. 6, draw T T′ parallel to D P. These lines being drawn in both figures, the following investigation will apply to either.

Let $D\,C = b = C\,G + G\,T' + T'\,D$
$P\,Q = c$
$F\,H = r$
$P\,D = s$
$G\,C + F\,H = a =$ the horizontal distance of H from the main centre + ($\frac{1}{2}$ versine arc $D'\,D\,D'' \times \frac{s - c}{s}$ *

It may be proved in the same way, as for fig. 4, that the point P moves in a line parallel to that described by the point E, so that the inquiry resolves itself as before into an investigation of the relative lengths of C G, and F H, that will cause the point E to move in a perpendicular line. Let us suppose, first, that the height of the centre H of the radius bar, and consequently the height also of the pin Q is fixed, and that the point G, or the length of C G, is also determined. It is required to find from these data the proper length of H F. By equation (A) we have

C G : F H : : F E : E G, but by similar triangles F T : G C : : F E : E G;

$$\text{hence, } T\,F : G\,C : : C\,G : F\,H = \frac{G\,C^2}{T\,F} = \frac{G\,C^2}{T'\,G}$$

but, $T'\,G = C\,T' - C\,G$, and by similar triangles

$$D\,P : Q\,D : : D\,C : C\,T' = \frac{D\,C \cdot Q\,D}{D\;P} = \frac{b\;(s - c)}{s}$$

$$\text{hence, } T'\,G = \frac{b\;(s - c)}{s} - C\,G = \frac{b\,(s - c) - s \cdot C\,G}{s}$$

$$\text{and, } F\,H = \frac{G\,C^2 \cdot s}{b\,(s - c) - s \cdot C\,G} \ldots\ldots\ldots\ldots\ldots\ldots (D)$$

Again, if the length of G C is not given, but the positions of the centre H, and the pin Q are fixed, let it be required to find the lengths of H F and G C. We shall have the same as above

$$F\,H = \frac{G\,C^2}{T'\,G} = \frac{(a - r)^2}{T'\,C - a + r}$$

$$\text{or, } r = \frac{(a - r)^2}{T'\,C - a + r}$$

$$\therefore r\,(T'\,C - a + r) = a^2 + r^2 - 2\,a^2$$

$$\therefore r\;(T'\,C + a) = a^2$$

$$\therefore r = \frac{a^2}{T'\,C + a}$$

But it was shown above that $T'\,C = \frac{b\,(s - c)}{s}$ hence

$$r = \frac{a^2\,s}{a\,s + b\,(s - c)} \ldots\ldots (E)$$

This equation will give the length of H F, and to get G C we have

$$G\,C = a - r \ldots\ldots\ldots\ldots (E')$$

Again, suppose that the lengths of the levers H F and C G, and consequently the horizontal distance of the centre H from the main centre are given. Let it be required to find the height of the centre H and point Q.

From equation E we get

$$a\,s \cdot r + b\,(s - c) \cdot r = a^2\,s$$

$$\therefore a\,s\,r + b\,r\,s - b\,r\,c = a^2\,s$$

$$\therefore b\,r\,c = a\,s\,r + b\,r\,s - a^2\,s$$

$$\therefore c = \frac{a\,s\,r + b\,r\,s - a^2\,s}{b\,r} = \frac{(a\,r + b\,r - a^2)\,s}{b\,r}$$

$$\text{or, } c = \frac{(a + b)\,r - a^2}{b\,r}\;d\,s \ldots\ldots (F)$$

It may be observed that, if c in formulas (D) and (E), is taken equal to nothing they become the same as formulas (B) and (C).

Having now investigated formulas for calculating the proportions of all the parallel motions we proposed to examine, we shall conclude by collecting these formulas together for the greater convenience of reference, and subjoin practical rules deduced from them for the use of those who prefer rules to algebraic formulas.

The sum of the lengths of the radius bar, and the part of the beam (C G) which works it . . . = a = Horizontal distance of the centre of the radius bar (H) from the main centre, plus half the versed sine of the arc described by the extremity of the beam (D) *

Radius of side lever or engine beam, (D C) . . . . = b
Length of radius bar . . (H F) = r
Length of side rod . . (P D) = s
Part of side rod above the centre of radius bar . . (P Q) = c
Part of connecting link intercepted between the beam and the point E (G E) . . . . = p
The remaining part of the connecting link . . . (F E) = p'
Length of that part of the beam that works the radius bar . (G C) = r'

$$\left.\begin{aligned} r &= \frac{r' \,.\, p}{p'} \\ p' &= \frac{r'\,(p + p')}{(r + r')} \end{aligned}\right\} \;.\;\;.\qquad \text{Figs. 1 and 2} \ldots\ldots (A)$$

$$r = \frac{r'^{\,2}}{b - r'} \;.\;\;.\;\;.\qquad \text{Figs. 3 and 4} \ldots\ldots (B)$$

$$r = \frac{a^2}{b + a} \;.\;\;.\;\;.\qquad \text{Figs. 3 and 4} \ldots\ldots (C)$$

$$r' = a - r \;.\;\;.\;\;.\qquad \text{Figs. 3 and 4} \ldots\ldots (C')$$

$$r = \frac{r'^2\,s}{b\,(s - c) - s\,r'} \;.\;\;.\qquad \text{Figs. 5 and 6} \ldots\ldots (D)$$

$${}^{*}r' = \frac{a^2\,s}{a\,s + b\,(s - c)} \;.\;\;.\qquad \text{Figs. 5 and 6} \ldots\ldots (E)$$

$$* \quad r' = a - r \;.\;\;.\;\;.\;\;.\qquad \text{Figs. 5 and 6} \ldots\ldots (E')$$

$$\left.\begin{aligned} * \quad c &= \frac{(a + b)\,r - a^2}{b\,r}\,s \\ * \;\text{Or } c &= \left\{1 + \frac{a - a^2}{b\,r}\right\} s \end{aligned}\right\} \;.\;\;.\; \text{Figs. 5 and 6} \ldots\ldots (F)$$

Rule I.—*In such a combination of two levers as is represented in Figs. 1 and 2, to find the length of radius bar required for any given length of lever C G, and proportion of parts of the link, G E and F E, so as to make the point E move in a perpendicular line.*

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* $\frac{1}{2}$ versine of arc $D'\,D\,D'' \times \frac{s - c}{s}$ is the excess of the distance of the point D, from the line R S, over the distance of the point Q from the same line. Comparing this with the last note, the correctness of the value given above to a will be evident.

* In formulas (E) (E′) and (F) a is to be taken equal to the horizontal distance of H, from the main centre, + ($\frac{1}{2}$ vers. arc $D'\,D\,D'' \times \frac{s - c}{s}$) In formula (F) the value of $\frac{s - c}{s}$ cannot be accurately ascertained till the value of c has been calculated, but it can easily be taken by approximation, with sufficient exactness for the practical application of the formula.

Multiply the length of G C, by the length of the segment G E, and divide the product by the length of the segment F E. The quotient is the length of the radius bar.

RULE II.—(*Fig.* 2.) *The length the radius bar and of C G being given, to find the length of the segment* (*F E*) *of the link next the radius bar.*

Multiply the length of C G by the length of the link G F, and divide the product by the sum of the lengths of the radius bar and of C G. The quotient is the length required.

RULE III.—(*Figs.* 3 *and* 4.) *To find the length of the radius bar* (*F H*), *the length of C G being given.*

Square the length of C G, and divide it by the length of D G. The quotient is the length required.

RULE IV.—(*Figs.* 3 *and* 4.) *To find the length of the radius bar, the horizontal distance of its centre* (*H*) *from the main centre being given.*

To this given horizontal distance, add half the versed sine (D N), of the arc described by the end of beam (D). Square this sum. Take the same sum, and add to it the length of the beam (C D). Divide the square previously found by this last sum, and the quotient is the length sought.

RULE V.—(*Figs.* 5 *and* 6.) *To find the length of the radius bar, C G and P Q being given.*

Square C G, and multiply the square by the length of the side rod (P D): call this product A. Multiply Q D by the length of the side lever (C D). From this product subtract the product of D P into C G, and divide A by the remainder. The quotient is the length required.

RULE VI.—(*Figs.* 5 *and* 6.) *To find the length of the radius bar; P Q, and the horizontal distance of the centre H of the radius bar from the main centre being given.*

To the given horizontal distance, add half the [*] versed sine (D N) of the arc described by the extremity (D) of the side lever. Square this sum and multiply the square by the length of the side rod (P D). Call this product A. Take the same horizontal distance as before added to the same half versed sine (D N), and multiply the sum by the length of the side rod (P D): to the product add the product of the length of the side lever C D into the length of Q D, and divide A by the sum. The quotient will be the length required.

When the centre H of the radius has its position determined, rules 4 and 6, will always give the length of the radius bar F H. To get the length of C G, it will only be necessary to draw through the point F, a line parallel to the side rod D P, and the point where that line cuts D C will be the position of the pin G.

In using these formulas and rules, the dimensions must all be taken in the same measure; that is, either all in feet, or all in inches; and when great accuracy is required the corrections given in Table (A), must be added to or subtracted from the calculated length of the radius bar, according as it is less or greater than the length of C G, the part of the beam that works it.

EXAMPLES.

1. Rule 4.—Let the horizontal distance (M C) of the centre (H) of the radius bar, from the main centre be equal to 51 inches; the half versed sine D N = 3 inches, and D C = 126 inches. Then by the rule we will have

$$\frac{(51 + 3)^2}{51 + 3 + 126} = \frac{(54)^2}{180} = \frac{2916}{180} = 16{\cdot}2 \text{ inches,}$$

which is the required length of the radius bar (F H).

2. Rule 5.—The following dimensions are those of the Red Rover Steamer: C G = 32 D P = 94 Q D = 74 C D = 65 P Q = 20.

By the rule we have, $A = (32)^2 \times 94 = 96256$ and

$$\frac{96256}{74 \times 65 - 94 \times 32} = \frac{96256}{1802} = 53{\cdot}4$$

which is the required length of the radius bar.

3. Rule 6.—Take the same data as in the last example, only supposing that C G is not given, and that the centre H is fixed at a horizontal distance from the main centre, equal to 83·5 inches. Then the half versed sine of the arc D′ D D″ will be about 2 inches, and we will have by the rule

$$A = (83{\cdot}5 + 2)^2 \times 94 = 705963{\cdot}5 \text{ and}$$

$$\frac{A}{85{\cdot}5 \times 94 + 65 \times 74} = \frac{705963{\cdot}5}{1284{\cdot}7} = 54{\cdot}8 \text{ inches}$$

the required length of the radius bar in this case.

In both of the last two examples $\frac{C\,G}{H\,F} = {\cdot}6$ nearly. The correction found by Table (A), therefore, would be 54 × ·027 = 1·458 inches, which must be subtracted from the lengths already found for the radius bar, because it is longer than C G. The corrected lengths will therefore be

in example 2 .... F H = 51·94 inches
in example 3 .... F H = 53·34 ,,

ART. XV.—ANALYSIS OF BOOKS.

De l'Etat actuel de la Navigation par la Vapeur. Par A. CAMPAIGNAC. Paris: Mathias, 1842.

THIS is a work of much utility, and not inconsiderable merit. It contains a digest of the knowledge relative to steam navigation, scattered through this country—executed, too, with considerable judgment, and manifesting an intimate acquaintance with the subject. We cannot, within our present limits, give any more detailed information relative to the contents of this volume, but will probably return to it next month, when we hope to be able to give our readers a tolerable idea of its quality.

Designs illustrative of a new Plan of a Circular Chapel, &c. By ANDREW SCOTT, London: printed by Tyler and Reed, Bolt-court.

WE leave Mr. Scott to state the circumstances in which his proposition to employ a circular form of chapel originated:—

"That the Home Missionary Society has had a station and agent at Walton-on-Thames since 1839. That his stated religious services have been carried on in a room belonging to a public-house; and whether the disadvantages of an association so incongruous, or those of a heated, badly-ventilated room, or those of the absence of such a classification of the hearers as pews give be referred to, the importance and necessity of a chapel has been acutely felt, and which has been manifested by numerous attempts to procure at Walton ground for effecting this object. That every expectation of succeeding in getting ground at Walton having failed, the undersigned is induced to offer for the erection of a chapel a highly eligible piece of freehold ground, at Hersham, a hamlet of Walton. That to carry this object into effect, on the scale of the circular one, with a moderate sized vestry attached, a sum exceeding 500*l.* is required. That the undersigned, besides the ground, will give in cash 50*l.*, and which, with 30*l.* already paid by a clergyman of the Church of England, and promises from friends in the neighbourhood, goes to make nearly 200*l.*, and that this leaves fully 300*l* depending on the kindness and liberality of friends not yet applied to. That when the 500*l.* is raised, the undersigned will commence and complete the erection of the proposed chapel, with vestry attached; he reserving a claim on the building for any sum not exceeding 100*l.*, that he may find necessary to expend over the 500*l.* to complete the object."

This proposal does Mr. Scott great credit, originating, as it evidently does, in purely philanthropic motives. His views respecting the advantages of the circular form of building are, we think, just and judicious; but some of the details—particularly the complicated roof, with its central prop—we do not at all like. We should much prefer a simple dome; and, for a building of only thirty-six feet in diameter, a light dome, of zinc, might, we think, be made at a very moderate cost, which would completely answer every purpose. The zinc would require to be felted on the inside, else the building would be greatly affected in its temperature by atmospheric vicissitudes. The felt might be plastered upon or painted, having first undergone a suitable preparation.

A dome of this kind, supported by Caryatides figures, and all the rest of the building quite plain, would look extremely well; and such figures might be had, made out of artificial stone, at a moderate expense. It is in these smaller works that new adventures in architecture should be made; and by adding a novelty of decoration to a novelty of plan, Mr. Scott would not merely be conferring a benefit upon his immediate neighbourhood, but rendering an important service to the ornamental arts.

Observations on the Extraction of Teeth. By J. CHITTY CLENDON. London: S. Highley, 1843.

THIS little work is upon a subject somewhat removed from our ordinary pursuits; but is one, nevertheless, in which every one subject to the toothache will take an interest. Mr. Clendon's main object, as we apprehend him, is to denounce the use of the claw in tooth-drawing, and use the forceps exclusively. The objections to the claw he mentions, are, no doubt, weighty; but an objection has applied to every description of forceps we have seen; some are too clumsy for the mouth, and others not sufficiently powerful; added to which, most of them require a length of time in fixing that is distressing to the more nervous class of patients. Nevertheless, the principle of the forceps is, we are persuaded, the best. The claw has a leverage that is dangerous in rough hands, and sometimes has ended in the fracture of the jaw. There is one variety of forceps we have seen which operates by means of a leverage, the resisting points of which are the teeth before and behind the one to be extracted. This throws a great pressure on them; and when the teeth before and behind are wanting, the instrument is inapplicable, without the addition of one or two descending feet, which has the effect of making the combination impracticable, for all mouths, except such as adorn the Bull and Mouth office in Regent-circus.

We have only to add, that Mr. Clendon's book is, to our mind, a very good one. It contains, it is true, no views of any very great novelty; but it is judicious and well written; and manifests, so far as we are able to judge, a sound practical acquaintance with the subject.

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[*] If great accuracy is required, in place of D N in this rule take D N multiplied by D Q, and divided by P Q.

ART. XVI.—MARVELS OF THE DAY.

Heat Reproducer.—Of this contrivance we can only as yet give a very general account, as it has not as yet been applied to any useful purpose. The object of the contrivance is to concentrate heat, so that a large volume of heat (so to speak) of a low intensity may be turned into a small volume of a high intensity. The operation of the apparatus is, therefore, analogous to that of a crane, or hydraulic press, in converting a large quantity of motion with a small pressure into a small quantity of motion with a great pressure; and no more involves the supposition of creating heat out of nothing, than the mechanical contrivances we have mentioned require us to suppose that they have created power out of nothing.

But we can give still more approximate illustrations. A burning-glass concentrates into a small space those rays of the sun due to a large superficies, converting what would otherwise be only a moderate warmth into a very intense heat. The burning-glass may, therefore, be looked upon as one of the *calorific powers;* and, although this particular one may be inapplicable to practical uses, it is certainly conceivable enough that others may exist of a more facile applicability. Thus heat may be expressed from any gaseous body, as every one must know who has lighted tinder by an air-syringe; and although there is power absorbed in effecting this compression, yet, under suitable circumstances, the most of this power will be given back again in the re-expansion of the air. There are, it is true, grave objections against the application of any such plan as this in practice; but those objections are accidental merely to this particular phase of the principle, and form no necessary part of it. In the contrivance to which we have adverted such objections do not exist; and we have merely introduced these primitive and familiar illustrations to show that there is no absurdity in supposing that heat of a high intensity may be produced out of heat of a low intensity; and that any incredulity on such a subject only springs out of the narrow knowledge of the unbeliever.

The consequence of a regeneration of heat such as we have mentioned, is obviously to enable us to work a steam engine without any expenditure of fuel. The hot water pumped out by the air-pump contains as much heat as will re-produce the original quantity of steam expended; and all that this contrivance does, is to accomplish the transformation.

Engines for the "Penelope" Frigate.—These engines, constructed by Messrs. Seaward and Capel for a frigate which is to be turned into a steam vessel, are now completed. They are of the "direct action" description, as it is called, with the connecting-rod joined immediately to the piston-rod, and situated beneath the crank. In short, these engines very much resemble those of the "Gorgon," and have all the vices and virtues of that rather heathenish variety.

There are two engines, arranged side by side in the usual manner. The diameter of cylinder is 91⅝ inches; length of stroke 7 feet 6¾ inches—though of this dimension our informant did not himself seem very confident; the number of nominal horses' power, 625; pressure of steam in boiler 9 lbs.; and the valves are so made as to be capable of cutting off the steam at any part of the stroke between the points of one quarter and three-quarters of its length. The engines are furnished with Hall's condensers, which contain only about *twenty-two miles* of pipe.

The most remarkable characteristic of these engines, next to their great size, lies in the description of valve which has been adopted, and of which we must endeavour to convey some notion to our readers. There are four ports, then, to each cylinder, two of which are situated at that part of the cylinder nearest the condenser, and two at that part which is the most remote—in other words, at the end of the engines. By these latter ports the steam is admitted, while by the other two it is let out; and the whole of these ports, whether steam or eduction, are closed by iron plates, which open and shut like sluices. The upper steam valve, too, is connected with the under eduction valve, and *vice versâ,* by rods, which form a sort of St. Andrew's cross, against the inner side of each cylinder, so that these connected valves are opened and shut simultaneously; and motion is imparted to this Siamese combination by cams upon the shaft operating on rollers at the ends of levers, and which move the levers and their attachments in the required manner. There is, therefore, no eccentrics required for these engines, as the aforesaid cams fulfil the eccentric function,—the one combination of steam and eduction valve being moved by a lever situated before the shaft, and the other combination by a lever situated behind the shaft; and the two levers are therefore moved by the one cam. Each cam consists of three brass discs, about an inch thick, with the requisite protuberances for moving the levers; and the protuberances of these plates may either be made coincident, or be moved a certain distance forwards or backwards, so as virtually to make the total protuberance more or less extended. The rollers upon which the cams operate are of the united width of the discs forming the cam; so that to prolong the protuberance of any one has the same effect upon the movement of the valves as if the whole were extended; and it is by altering the relative positions of these discs upon the shaft, so as to make the resulting protuberance longer or shorter, that a variation in the expansion is accomplished. The rollers are retained up against the cams by enormous spiral springs, which manifestly require to be of sufficient strength to overcome the resistance occasioned by friction of the valves.

There is much that is bad, we fear, in all this. The complication of the valve gearing is greater than any we have ever seen, while we have not been able to find that it confers any benefits which are not attainable by less astonishing expedients. The friction, too, of the sluice-plates, with the whole unbalanced pressure of the steam acting upon a large superficies, must be much greater than in the case of packed valves of the common kind; while the breadth of the cam, which has to overcome this friction—in some places only about an inch—is, in our apprehension, insufficient for any great durability. There are two starting-handles to each engine, situated one above the other, and extending fore and aft between the engines; and the engineer has to work both of these handles in starting. The operation of starting must, we fear, be attended with much difficulty, on account of the great pressure to which the valves must be subject; and, in the case of condensation by external cold, this pressure cannot be materially alleviated by vitiating the vacuum by an admission of steam. The handles, too, if at any time moved by the engines, will, at some parts of their movements, cross one another like a pair of shears; and any such clipping action, in the very part the engineer requires to handle and be beside, must, we think, be a source of much danger. This, it is true, is, after all, but a small matter; yet it is one of too much consequence to be left altogether out of the account; and we have certainly very little sympathy with that philosophy which would make the safety of the engineer a matter of trivial importance.

We have dwelt so long upon what we consider the deformities of these engines, that we have left ourselves but little room to descant upon their perfections. The workmanship is both excellent and abundant, the more costly materials are unsparingly introduced, and the general arrangement and construction are, we think, judicious. The method of keeping up the circulation of water around the pipes of the condenser, or, rather, of working the pumps which maintain that circulation, is the best we have seen. It consists in the application of a square pump upon each side of the air-pump; and these pumps are wrought immediately off the air-pump cross-head.

Such, then, are the chief characteristics of these engines. As a whole, we think they are of excellent quality; and all their most serious parts will, we believe, operate well. But to the valve apparatus we cannot extend our praise, and, to speak the honest truth, we think that this part of the machinery does more credit to Messrs. Seaward's enterprise than to their ingenuity.

The Waterman, No. 9.—We have here a perfect ship-load of novelties, and all of them have had the rare good fortune of answering their intended purposes. Indeed, this little vessel has approved herself to be, in point of speed, the most successful production of the day: she completely outstrips every vessel of her own class, and is a fair match for vessels of higher power and greater pretensions. We are, however, going before our story.

The "Waterman, No. 9," is a little iron steamer, constructed by Mr. Napier, of Millwall, for the Waterman Company, under the guarantee that she should beat every vessel of her class, and burn less fuel; both of which feats she has achieved. Her length, between perpendiculars, is 107 feet; breadth at paddle-boxes, 15 feet; depth, 7ft. 2in.; draught of water, 2ft. 9in. The vessel is propelled by one engine, with a cylinder of 30 inches diameter, and 3 feet stroke, which is supplied with steam by a cylindrical boiler 7 feet in diameter. The boiler is placed in the vessel upon its end, so that it only occupies a superficies of the vessel's floor equal to that of a circle of 7 feet in diameter. The bottom of the vessel is made double, and the space between the two bottoms is made available for accomplishing the condensation of the steam by external cold. The boiler is consequently supplied only with clean and fresh water; and should the bottom of the vessel be injured by any casualty, no leakage into the ship can, therefore, ensue. If the damage be trifling, the only effect will be, that the air-pump will have more water to lift out; and if the damage be excessive, the air-pump can be thrown out of connexion, and the engine worked by the simple pressure of the steam.

The engine of this "Waterman" is of the kind called "direct action;" but its *directness* is of a peculiar description. There are four piston-rods, which are prolonged above the shaft by a distance equal to the length of the connecting-rod. Upon the top of these piston-rods a cross is placed, and from the centre of this cross the connecting-rod is hung. The air-pump, feed-pump, and bilge-pump, are wrought by a short lever, one end of which is attached by links to the cross.

The paddle-wheels are made with feathering-floats, which enter and leave the water perpendicularly, or at any desired angle, in a manner similar to that of Morgan's wheels. The parallelism, however, is differently maintained, being accomplished by a ring suspended in a position eccentric to the wheel by the crank-pins of cranks attached to each float. The weight of this ring tends to keep all the floats perpendicular; but, for greater security, rollers are attached to the side of the vessel in such a position that this ring revolves round them, thereby rendering the parallelism imperative.

The most extraordinary part of this vessel, however, is the boiler, which, as we have stated, only occupies a circle of 7 feet in diameter upon the bottom of the ship. It is higher, however, than ordinary boilers, and projects several feet above the deck; but, in the case of a river vessel, we do not see that this peculiarity is any material disparagement. The fire-grate of the boiler is cylindrical, and is of the diameter of the shell, diminished by the breadth of a water-space all round. Above the fire, a water-space of 14 inches in depth extends all over the grate, with the exception of a space left at that part most remote from the fire-door for the escape of the smoke. All above this horizontal water-space is one large chamber, in the middle of which the chimney is situated; but around the chimney are a number of concentric circles of locomotive tubes, communicating at their under ends with the water in the horizontal water-space, and at their upper ends with the water reposing on the top of the chamber. The hot air proceeding from the fire must, before it can reach the chimney, wend its way through this forest of brass tubes; in which operation it is robbed of its heat to the uttermost farthing. The steam-producing powers of this boiler are very great, and its consumption of fuel is exceedingly moderate—chiefly, we suppose, in consequence of the thorough extraction of the heat, which the coolness of the chimney indicates. Every part of the boiler is accessible for repair, and the whole apparatus is compact, efficient, strong, and inexpensive. Upon the whole, we should be disposed to say, that, for cases where there is no smoke and no salt water, this description of boiler is the very best we have ever met with.

We cannot afford to say more at present respecting this extraordinary little vessel. The various contrivances by which she is distinguished, are, we think, unequalled for ingenuity and judiciousness, and they certainly perform their functions well; yet the *finish* of the engines is inferior to that which shines out in the work of many other makers, and does not come up to our ideas of the developments of such a quality. In this respect this vessel is, in our judgment, too much of an American; and although many persons may look upon such imperfections as insignificant, they are not, we think, even on their own account, to be altogether despised; and, even were the case otherwise, should still, we submit, meet with some consideration, so long as they constitute the elements out of which the judgments of the unskilful are almost exclusively elaborated.

Electro-Magnetic Engine.—This is an engine now exhibiting at the Egyptian Hall, for obtaining a motive power from galvanism through the agency of a temporary magnet. The principle of the plan is thrown into a variety of different shapes, of which the most interesting in our eyes, is that by which a rotatory motion is imparted to a drum of wood, and iron disposed in alternate radial layers. We must endeavour to make the *modus operandi* of this machine intelligible to those of our readers who may not have had an opportunity of visiting the exhibition.

In the drum, which is for the most part composed of wood, three large pieces of iron are inserted; and on the frame which supports the drum, two large horse-shoe pieces of iron wrapped round with copper wire are fixed; one before the drum, and the other behind it. By a proper arrangement of little cams on the shaft of the drum, the copper wire wound round each of the pieces of iron is connected, and disconnected with a galvanic battery alternately; and when the battery is connected with the one piece of iron it is disconnected from the other; so that when one of the pieces of iron is changed into a temporary magnet by the galvanic current, the other remains merely as a piece of inert iron. The consequence of this arrangement is, that the horse-shoe piece of iron, which is *pro tempore* changed into a magnet, attracts the piece of iron nearest to it on the drum, thus putting the drum into revolution; and by the time that the revolution of the drum has brought this piece of iron opposite to the magnet, the cams have changed the connexion of the wires, so that the piece of iron which has just been acting as a magnet becomes inert; and the piece of iron, upon the other side acquires magnetic efficacy, by which means the rotation of the drum is continued.

The value of all such means of acquiring motive power, depends altogether upon its economy in comparison with other methods. Mr. Davidson, by whom these machines have been invented, informs us, that the power he consumes is actually produced at no cost; inasmuch as the sulphate of zinc produced by the action of the acid upon the plates in the galvanic trough, will realize by its sale more than sufficient to replace the plates and acid. But we do not think this would be the case, if the plan were to come into any considerable use, as the sulphate of zinc, being an article of limited consumption, would not meet with an increased sale, corresponding to the increased production; and, would, therefore, fall in price. Nevertheless, the salts of zinc are fast coming into a more extended use: they are, for example, now used in preserving timber from rotting, and in coating iron with metallic zinc, and the demand for them would no doubt be much increased, if their mode of production could be considerably cheapened. Still, we fear, even with those additional outlets, the salts of zinc would, if Mr. Davidson's plan were to be adopted to any considerable extent become a drug in the market; and we do not therefore anticipate that his plan will ever supersede the steam-engine, so long as it is clogged by the objection to which we have adverted. Cheaper means, however, may be found out of generating the galvanic fluid, and when that is done some such machine as Mr. Davidson's must supersede the existing methods of producing motive power.

We cannot dismiss this subject without bearing testimony to the great ingenuity displayed by Mr. Davidson, in his various contrivances. This exhibition will not, we think, become popular with persons those who expect a scientific exhibition to be made up of glitter and frivolity; but no mechanic can visit it without becoming impressed with the great merit of Mr. Davidson's contrivances, as well as with the modesty of the contriver.

The Aerial Navigator.—The purpose of this invention is to navigate the aerial spaces by the agency of gas, and accomplish voyages to very lofty places—perhaps, even to the moon. To some of our readers, such a scheme may perhaps appear impracticable; but they have not, we believe, sufficiently reflected on the great imponderability of the aerial gas, or on the indubitable lunar qualifications of the inventor. These will, perhaps, more clearly appear by a few extracts from the inventor's own account of the contrivance, which will serve the further useful end of saving to us a serious expenditure of panegyric.

"This gigantic production of the genius of man, will assuredly become the greatest of all mechanical wonders, when its mighty powers for good and for evil are hereafter developed.

"Aerial locomotion, on the old balloon principle, has had its allotted time for exciting the wonder and admiration of the curious; but like stage coaches, balloons will soon be numbered among the things that were, as atmospheric machines of the above description are gradually adopted; in reality, annihilating both time and space, and by a more rapid intercommunication destroy the prejudices of nationality, and thus conduce to moral happiness.

"No. 10 shows an *Observatory*, with a most beautiful and very powerful telescope, on the same principle as Sir John Herschell's grand instrument at the Cape of Good Hope. The mode of ascent and descent is by an inclosed staircase, very curiously constructed. Like the gentleman here observed to be looking through the telescope, all lovers of science can enjoy themselves with greater pleasure than can be experienced on the earth."

This must be admitted to be very convincing; yet we fear the inventor has acted unwisely in bringing these felicities so prominently forward at the present stage of his progress. The invention can hardly now fail to meet with the strenuous opposition of clergymen of every persuasion, who will naturally be alarmed for their monopoly, by the introduction of this patent plan of getting to heaven.

The navigator is impelled, in any desired direction, by fans, paddles, wheels, arms, wings, and tail, to which motion is imparted by a steam engine of great power. The chimney of the boiler passes up through the middle of the balloon; and, of course, would not be in the least likely to get bent, either to the one side or the other, by the occasionally diverse motions of the balloon, and the ship suspended from it, and in which the boiler is placed. No cracks or crevices in the chimney, moreover, could arise; and no escape of gas which might lead to the explosion of the balloon. These are difficulties which can only be contemplated by ignorant and timid persons; and the drawing shows, most conclusively, that they could not arise. Not only is there no explosion to be seen, but there are ladies and gentlemen, sitting perfectly at their ease, and looking out of the window.

The Navigator, we ought to have mentioned, consists of a ship hung from a balloon. It is in the ship, of course, that the passengers are carried; and it is divided into an upper and lower story, for their better accommodation. Besides passengers and their accoutrements, the ship carries twenty-two swivel guns and a quantity of military stores, besides two soldiers to parade the deck, and a sailor to hurrah from the rigging. Accommodation is to be provided for fifty passengers, and the engine is to be of 200 horses power. Of course, a very moderately-sized balloon would lift all these accumulated weights, consisting of passengers with their luggage, guns with their shot and powder, steam engines with their boilers and coals, besides the fans, arms, oars, etc. The height of a homogeneous atmosphere is known to be about five miles, which is equivalent to fifteen pounds of pressure on the square inch; so that supposing the ship were to be made so shallow that every square inch of its horizontal superficies were to weigh only fifteen pounds, the height the balloon would require to be, supposing the gas it were inflated with not merely was lighter than coal gas, but had no weight at all, would be only about five miles, to lift the weight of the ship off the ground with a horizontal area of balloon equal to that of the ship. A balloon five miles in height would, of course, be easily manageable in practice, and might manifestly be propelled against the wind with the greatest facility.

The Aerial Steam Carriage "*Ariel.*"—The plan we have just described is so manifestly impracticable, as to be unworthy of being spoken of seriously. It is, in fact, a parody upon the true aerial machine, and the absurd placard from which our extracts are taken was, no doubt, brought out as a catch-penny speculation, the public appetite having been so whetted by the mysterious accounts of the real machine, that anything was likely to be swallowed. We have thought it right to prefix a notice of this bubble to our account of the real machine, partly as an illustration of the popular credulity which has manifested a certain degree of faith in the absurdity, but chiefly because it furnishes us with an opportunity of disabusing those who conceive that this preposterous caricature constitutes the veritable invention.

The true aerial locomotive is the invention of Mr. Hanson, and is intended to operate on the principle of a kite, without any balloon at all. It consists of three main parts; viz., the body, which resembles a ship, set on wheels; the elevator, or kite, by which it is to be kept suspended in the atmosphere, and which consists of an immense rectangular frame of canvas, 150 feet long by 30 feet wide, extending across the ship at a small angle with the horizon, that part of the frame nearest the bow being the most elevated; and a tail of 50 feet long, resembling the tail of a bird, by which the upward and downward motion of the machine is regulated, or which, in other words, determines the angle of the ship's course to the horizon. The propulsion is to be accomplished by two great vanes, like windmill wheels, 20 feet in diameter, situated at the stern, which are to be worked by a steam engine of 20 horses power. The steam from the engine is to be condensed in copper chambers, kept cool by the current of air, so that the water may be used over again for replenishing the boiler.

There is nothing absurd in this general statement of the principle, but if we bring the project to the test of figures it will at once, we think, appear to be a delusion. The elevating power resides exclusively in the kite, and if we suppose that the machine is going at the rate of 60 miles an hour, and that the kite is fixed at the angle of 45°, at which point its sustaining power will be greatest, the power requisite for overcoming the resistance the locomotive experiences, will only be about 700 horses! This is a matter of simple calculation, as will appear by the following.

The perpendicular area of the kite exposed to the action of the wind is 3213 feet, the total pressure of the air upon which area at 60 miles per hour, is 13,144 lbs., which × by 1,760, the number of feet in a mile, and ÷ 33,000 the number of lbs. raised 1 foot high in a minute by a horse power = 701 horses. Of this power one-half is devoted at the angle of 45° to the sustaining of the weight, so that at the velocity of sixty miles per hour, and with the kite at an angle of 45°, the total weight of the locomotive with its boilers, condensers, fuel, passengers, and 700 horse power engine, must not exceed 6,572lbs. This weight, at the rate at which our most approved marine-engines are constructed, would only be equivalent to about 3 horses power, irrespective of the weight of fuel; and supposing that the engines of this ship were twice as light as those in our best steamers, their power could not exceed 6 horses, while it is necessary they should perform the work of 700, and this, too, supposing that the ship, vanes, kite, fuel, passengers, and provisions, were absolutely without weight. If the angle of the kite be diminished so as to make the resistance less, its sustaining power will be diminished in the same proportion; and making the calculation at any angle, it will be found that the sustaining apparatus will not support a tenth part of the weight requisite to keep it in action. We have in these considerations left out of account all estimate of the technical difficulties attendant upon such a machine—the impossibility by means of any conceivable fans to overcome a powerful adverse current—the danger of starting or alighting, and the fatal effects consequent upon any accident to the kite, tail, or other tackling, or to the engine by which the sustaining power is maintained. It is sufficient for us to have shown that this contrivance could not either raise or sustain a tenth part of its own weight, and our conclusions on this head are based upon physical laws, the truth of which cannot be disputed for a moment. We think it extremely reprehensible in newspaper philosophers to raise so great a noise about projects so completely visionary; and we think it redounds but little to the credit of our legislators to find them gravely entertaining schemes the absurdity of which is so glaring that even unlettered artizans like ourselves can only survey them with a mixture of pity, merriment, and contempt.

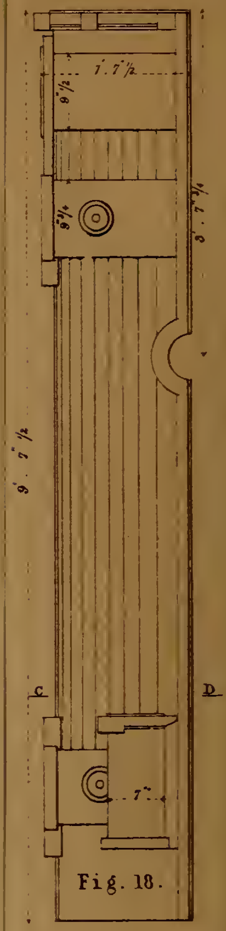

Fig. 18.

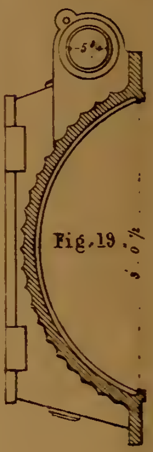

Fig. 19.

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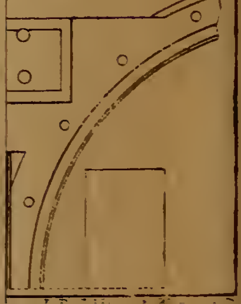


THE ARTIZAN.

No. IV.—APRIL 30th, 1843.

Art. I.—THE PHILOSOPHY OF ARCHITECTURE.

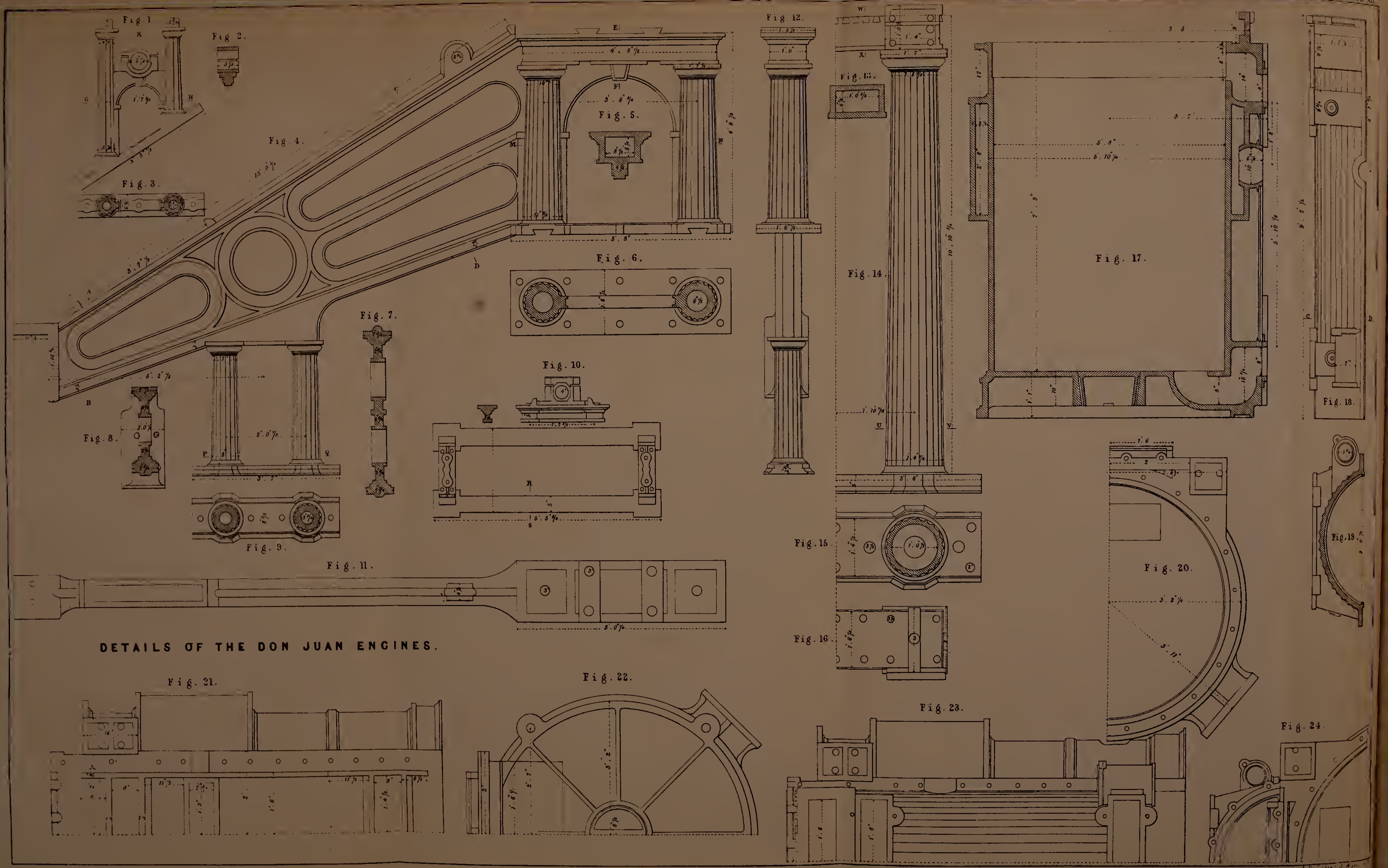
Architecture naturally divides itself into the two great heads of decoration and construction. The latter of these is a mere mechanic art, and involves no difficulty in its prosecution: the former is, in all its essential features, a fine art, and partakes of the dimness and mutability which belong to the operations of fancy. It is the decorative part of architecture to which, on the present occasion, we propose to limit our attention, and, indeed, it is this part alone which stands much in need of our elucidation. Not that we pretend to be able to bring forward any very new lights, much less to aspire to a comparison between our rude expositions and those inimitable discourses of some of our most eloquent essayists, which have embalmed the philosophy of taste in ' words of music;' but we trust to be able to give our readers a tolerably intelligible account of such of the leading principles of the fine arts as more particularly apply to architecture, and as are of the most signal importance to those who aspire to eminence in that profession.

To many of our readers it will probably appear very doubtful whether taste can have any philosophy at all. Philosophy supposes the existence of ascertained general laws: and what general laws, it will be asked, can there be, when no two men agree in thinking similarly of the same object? Every one admits lead to be heavy, grass to be green, and iron to be strong; and the truths of geometry have met with universal acceptation in all countries and times: but questions of taste are judged of differently by different nations and individuals, and appear to be more immediately dependent on the accidents of climate, custom, and civilization, than upon any inherent property of bodies, or any law of our common nature. The negro gallant of Soudan holds female beauty to be inseparable from woolly locks and an ebony complexion, and can survey the maidens of Greece or Circassia with indifference or aversion; while he again, who is intoxicated with the beauty of these ' daughters of Eden,' can see nothing but deformity in the Venus of the Hottentots. Different races, and different generations even of the same race, perceive beauty in objects in which other races or generations perceive none, or see only its opposite: and a subject may well be deemed impracticable which is bound up in predilections as capricious, seemingly, as the vicissitudes of the weather, and various as the degrees of latitude and longitude.

In spite, however, of all these anomalies, it appears nevertheless indisputable, that taste has a philosophy of which the leading principles may be traced, and an acquaintance with its laws may be acquired, by the same arduous and progressive means as knowledge of other kinds. Capricious and restive as the imaginations of men may appear, they are still governed by certain fixed and assignable causes inherent in the nature of things: and it cannot, we think, be doubted, that an acquaintance with these causes must be extremely useful to those who are ambitious of distinction in any of the imaginative arts. We do not, indeed, suppose that a man, to be a good poet, or painter, or architect, must first have mastered the philosophy of those arts; but we think that they who are familiar with the process by which the emotion of beauty is naturally called up, and who can distinguish those varieties of that emotion which are merely accidental from those which are universal and indestructible, will be much more likely to earn for their creations an extended and enduring fame, than if they appealed to narrower and more technical associations, or adopted, without reflection, those recipes of beauty which happened to be in fashion at the moment. The aid of philosophy, in achieving some such generalization, is now much more necessary than formerly. In ancient times the artist exercised a greater variety of functions, and was almost always a legislator and a soldier. His taste was, in consequence, less exclusive, and his associations more extended than is generally the case at the present day; and art was thus saved from the pedantry which naturally flows from its subdivision into numerous petty cantonments, the denizens of which are apt to think that there is nothing great or beautiful beyond the bounds of their own insignificant province. In the present state of society, the principle of the division of labour seems to be inseparable from the practice of every art; and the only safeguards we can see against the mannerism it is the tendency of this principle to introduce, lie in a comprehensive philosophy and a promiscuous education. There is no greater mistake than to suppose that the fine arts should appeal to technical, or remote, or learned associations. They should address themselves to emotions which spring up spontaneously in every heart; and those emotions will be the more true to nature, and the more likely to be the real representatives of the qualities by which they have been awakened, in proportion as they are unadulterated by the refinements of learning.—We cannot afford, however, to dwell longer on these topics, and must proceed, without further preamble, to the subject more immediately before us.

A disquisition on the philosophy of the fine arts naturally suggests two distinct subjects of inquiry; the one into the nature of Beauty, the other into the nature of Taste. The first has reference to those properties of objects by which the emotion of beauty is excited; the second to that condition or faculty of our minds which enables us to perceive that emotion. It is very necessary, at the outset, to understand that there are two distinct objects of inquiry, and that the one is in a great measure the key to the other, so that their investigation must go on simultaneously. It is from having overlooked this necessary division that much of the imperfection in most of our theories of beauty has arisen; for, after resolving, or pretending to resolve, all our perceptions of beauty into the perception of some fixed and physical property, it has appeared just as incomprehensible as at first how that property should affect the mind with the emotion of beauty. Hogarth's theory, for example, that all sorts of beauty may be resolved into the waving line, does not elucidate the nature of beauty in the least; for it is quite as difficult to see why one waving line should be beautiful, as why any combination of them should be so. The theory, moreover, although it may apply to some descriptions of beauty, does not apply to others. In architecture, for example, a beautiful building, or column, or pilaster, is bounded by straight lines, and the emotion of beauty would be at once destroyed by the substitution of waving lines in such situations.

Our first notions of beauty are, that it is a fixed property of certain bodies of which it is the function of the taste to take cognizance,—just as it is the function of the eye to take cognizance of colours, and of the ear to take cognizance of sounds. A moment's reflection, however, must show that this theory is not tenable; for it at once erects the power of perceiving beauty into a separate sense, and makes beauty a mere physical property, which is quite as measurable as gravity or temperature. If this were so, all men would see the same amount of beauty in the same objects, and could no more disagree as to what was beautiful, and what not, than they could now pretend that gold was not a heavy body, or fire was not a hot one. There might, indeed, be supposed to be some men without the required sense for perceiving beauty, and *their* opinions, it might be argued, would differ from the common standard; but such persons would only be unable to arrive at any conclusion at all,—just as a man, blind from his birth, can have no conception of colours, or a benumbed limb may be destitute of sensation. It is inconceivable, therefore, that if beauty were a fixed property, which it was the function of a distinct sense to perceive, men could differ materially in their judgments respecting it, much less that the same individual should fail to discern any beauty in the object by which, a few days previously, he was enchanted—the spell having in the mean time been broken by some new association. Every one feels, moreover, that the colours, forms, and proportions which are beautiful in one set of objects are by no means beautiful in all. The azure of the sky—the golden tints of the clouds at sunset, and the variegated vesture of the rainbow—these are all beautiful in their respective situations: but would any such assortment of colours be beautiful on the brow of a female? Would the colour of the grass be beautiful on the cheek of youth, or the proportions of a tree or a mountain be beautiful in a statue or a column? The fact is, objects agree in being beautiful which possess no other quality in common: and when we consider the multitude of things to which this quality applies—to things useless as well as useful, and moral and intellectual as well as physical—we shall at once see how hopeless must be the task of reducing all our emotions of beauty to such simple elements as variety, fitness, or fragility: and how vain must be the supposition, that beauty can consist in a physical property at all. The theory of beauty to which we profess ourselves to be adherents, and of which we now intend to lay some account before our readers, is, that there are no objects possessed of any absolute and intrinsic quality by which the sense of beauty is excited; but that the emotions of beauty or sublimity, which certain objects call up, are due altogether to their power of suggesting other objects to the imagination which are indelibly pleasing, simply because they are the natural representatives of love, joy, fear, pity, or some other social or selfish affection of our nature. This theory at once resolves all those perplexities relative to diversity of taste to which we have already adverted: according to it, those characteristics of objects which we distinguish by the term beautiful, are the mere symbols or mementos of certain elementary feelings with which they have become associated in the mind of the spectator; and to say that the same object is not beautiful in all eyes, is merely to say that a certain assortment of symbols is not significant to all minds of the same emotions. We may thus see why the fair skin and blooming complexion, which are beautiful in our eyes, because indicative of youth, and health, and vivacity, may excite very different emotions in the mind of the African, to whom they will be the



DETAILS OF THE DON JUAN ENGINES.

signs only of suffering and disease; or why the scenes of our childhood, or the music of our native land, may have a beauty to us, which is invisible, because inexistent, to every other observer. Thus, too, we may discover the secret of the extraordinary taste which it is the tendency of particular occupations to produce. The medical student, for example, will think an anatomical preparation beautiful, which will only be thought a most loathsome object by every body else; and the reason manifestly is, that in his mind it calls up trains of agreeable thought, whilst to other persons it is simply a symbol of pain and mortality. We thus seem to be incapable of separating the sensation due to the simple perception of an object from those more complex feelings which are consequent on its combination with the images pre-existing in the mind, and, by a natural though fallacious deduction, we set down the resultant of this complicated combination as due altogether to the object by which the movement was begun. The process of association, indeed, is so rapid, that we overlook all its intermediate stages—just as, in grasping any object, we overlook the operation of judgment involved in the estimate of its distance:—we see merely the beginning and the end of the process, and, as a necessary consequence, hang the resulting emotion on the object which originally called it up.

One of the chief sources of misconception which has existed on this interesting subject, is the notion that beauty is itself a definite and immutable quality, and that objects which are admitted to be beautiful must affect all minds in precisely the same manner. This, however, it is notorious, is not the fact; and if the emotion of beauty be merely the reflection of certain inward affections, it must, we think, be obvious that there must be as many varieties of beauty as there are of those affections. This doctrine experience fully confirms. Thus there are some sorts of beauty which are simple and unpretending—some animating and magnificent—and others august, commanding, and majestic. Some kinds of beauty appear to spring out of emotions of pity or affection—and some out of ideas of convenience, grandeur, or enjoyment, or out of awe, humility, or admiration: and the kind of beauty of which any object will be significant, will depend altogether upon the nature of the elementary feeling with which it may happen to be associated in the mind of the beholder.

It will be asked, however, what the elementary feelings are, by the suggestion of which the emotion of beauty is produced, and what concatenation subsists between beautiful objects and those elementary feelings. These topics we shall now attempt to illustrate; and, in the first place, we may observe, that all sensations which are vivid, and at the same time agreeable, may become the foundation of the quality of sublimity or beauty in external objects, when so connected with the sensations as to be capable of reminding us of them. It is not by any means an essential condition of this relation that those sensations should be purely pleasurable. In many of our emotions of beauty, the painful largely intermingles; and we know with what avidity spectacles of tragic impersonation are sought for in common life, which wring the heart with sorrow; yet in all such sensations of pain there is a still greater pleasure: and, indeed, the love of excitement—of deep, and even agonizing feeling, either experienced in ourselves or contemplated in others, is one of the most insatiable appetites of our nature. It is sympathy with the fortunes, either past, future, or conceivable, of some sentient being, that can alone invest any object with interest, or out of which our emotions of beauty and sublimity can be supposed to spring; and every feeling which it is agreeable to experience to recall, and which appeals powerfully to the heart and imagination, may become the parent of those emotions.

Of the nature of the connexion which subsists between those objects we distinguish as beautiful, and the feelings by the suggestion of which the emotion of beauty is produced, it is, fortunately, not necessary for us to say much. Almost every relation, whether natural or accidental, by which two objects can be held together in the imagination, or every analogy by which one object may recall the memory of another, may serve to connect the things we call beautiful with interesting and agreeable sensations. There are some of these relations, however, which are much more important than others, because more general and uniform in their application; and it is important, for our present purpose, that we should briefly notice the principal varieties.

The first and most important class of these relations is, where the association involves some natural law, and thereby acquires some of nature's universality and constancy. An example of this is to be found in the pleasure we derive from the perception of fitness—one of the most frequent and important constituents of beauty, and which is universally pleasing, simply because it conveys the idea of comfort and enjoyment—conditions universally coveted. It is on the same principle that the rising and setting sun—the firmament spangled with stars—the turbulent or tranquil ocean—the flicker of the lightning, and roar of the thunder—are universally sublime or beautiful; for they at once carry the soul to HIM who poured out the oceans, and built up the mountains, and reins the sun and planets within their orbits, and whose power and beneficence command the awe and gratitude of all men in all ages. The emotions, therefore, which spring out of the perception of these objects are very nearly the same in all minds, whether learned or untutored; and such objects may, therefore, be set down as the natural signs of the emotions they raise.

Should these illustrations appear to have any force, they will serve, perhaps, to aid our conceptions of one of the most difficult and embarrassing cases of beauty; namely, that of the human countenance. We are apt to imagine that the face of a beautiful female enchants us, merely by virtue of certain forms and colours, the combination of which gives us the emotion of beauty. But a little closer consideration will convince us that these forms and colours are delightful merely because they are significant to us of certain internal qualities which are primary objects of love and admiration. They are the tokens by which nature registers her gifts of youth and health and vigour, as well as of innocence, gaiety, and sensibility; and they would at once cease to be pleasing if they ceased to be representatives of those qualities. Had it been so ordained that the qualities which are now significant to us of hope and joy were the universal insignia of suffering and decrepitude—that the bright eye and elastic step and blooming cheek, which indicate health and vigour and vivacity, were the symptoms only of infirmity and decay—they could have been productive only of those melancholy emotions we now experience from the tottering gait and sunken cheek and wrinkled brow of age, and which are felt to be the lamented signs of pain and imbecility. In the moral qualities, the change in the expression would be quite as decisive: if, for example, the gaze which now bespeaks innocence and affection, were the seal affixed by nature to guilt and malignity—if the smile which is the symbol of intelligence or kindness, were the never-failing sign of inexorable cruelty, sullen idiotcy, or brutal passion—the spectacle of beauty would at once be disenchanted of its endearments, and we should turn from the countenance which now enchains us with feelings of abhorrence and aversion.

It may be objected to all this, that we know by our own experience countenances to be beautiful which bespeak neither innocence, intelligence, nor amiability; and that many countenances which bespeak those qualities are, nevertheless, not beautiful. This, no doubt, is, to a certain extent, true, but does not, we think, militate against the general hypothesis. Our emotions of beauty, it should ever be remembered, arise not so much out of the real existence of excellence as out of the appearance of it: and therefore, to say that beauty may exist without amiability, is merely to say that excellence may appear to be where it really is not. Of this excellence certain outward forms become significant, because, in by far the greater number of cases, they are its real concomitants; and this relation having become established in the mind, the sign will produce its accustomed impression even when affixed to an opposite perception. Thus a clear skin and blooming complexion, being common signs of health and vigour, become, so far, the foundation of emotions of beauty; and this relation having once become habitual, will continue undissolved even in cases where those peculiarities of complexion are notoriously symptomatic of suffering and disease. Thus the flush on the cheek of a hectic patient is felt to be beautiful; and although the discovery that it is a token of disease is necessarily attended with pain, yet this pain is produced by an act of reason, and is incapable of subverting the original emotion, simply because it is incapable of destroying the association of health and enjoyment, which are the *common* accompaniments of the characteristic. In like manner the forms and expressions of the human countenance, which are, in by far the greater number of instances, significant of innocence, kindness, or some other primary affection, come to be regarded as the natural signs of that affection, and will still continue to please, though disjoined from their proper signification, simply because they still suggest the accustomed emotion. To this we must add, that the emotions excited by female beauty are mixed up with associations which are, to a certain extent, sensual—which reconcile us in some degree to the absence of pure and lofty sentiment, and which are naturally gratified by the indications of feelings which are felt to be criminal and debasing. Our hatred of much that is unamiable in the female character has probably been considerably weakened by the action of this disturbing force, and a perplexity has been thrown over the whole inquiry, which, while its tendency is to lead inquirers astray, makes it at the same time almost impossible to point out the sources of their errors. Without entering further, however, on this embarrassing subject, we have probably said enough to show that the existence of beauty, notwithstanding the absence of any amiable quality, is reconcileable with the theory we have undertaken to expound. The attributes of youth and health, which are universally pleasing, are always present in such cases; and the other characteristics are attractive simply because they are the *ordinary* signs of innocence and amiability, and retain their power of suggesting the emotions to which they are for the most part united. The absence of beauty, where innocence and amiability are present, may be explained on the same principle: where not due to the absence of youth or health, there will usually be found to be some blemish or deformity which carries the idea of physical suffering or imperfection, and which may either weaken the primary feeling, or obliterate it by another of an opposite description.—We cannot afford, however, to dwell longer on this part of the subject, and perhaps have already said enough to convince the less incredulous of our readers that the beauty of the human countenance is not chiefly due to any mere assemblage of forms or colours, but to its significancy of kindly feelings and dispositions, and of that innocence, intelligence, and enjoyment, which are the natural objects of delight and admiration.

We have been thus diffuse in our exposition of this variety of beauty, partly because its apparent anomalies have been raised into an objection to the general theory, and partly because of the numerous and important relations it appears to have to other parts of the subject. One ingenious inquirer,* indeed, has lately held that the female form is the initiative of all our emotions of beauty, and that every object is beautiful precisely in the proportion in which it suggests that form to our imaginations. In this opinion it is needless to say we do not concur; and, indeed, we are at a loss to conceive how such objects as a mountain, or cathedral, or the ocean—all of which may be beautiful—can naturally, or, indeed, in any way suggest the idea of a woman. But the very existence of such an hypothesis carries an assurance to our mind that the relations of this description of beauty are very strong and very extensive, and may, perhaps, be accepted as some excuse for the time and space we have spent upon it.

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* Mr. Haydon.

We shall only add another illustration under this head of the subject, and that shall be of the manner in which the emotion of beauty may be raised by the suggestions of inanimate objects. A statue will, of course, at once suggest the idea of its prototype, and will be attractive either from the interest of the original object, or the skill shown in the imitation. A cottage may in like manner suggest the idea of the tranquil labours of a peasant's life; and verdant meadows, with cattle grazing, or fields waving with corn, ideas of peace, plenty, and repose. These objects may all appear beautiful, but they can only appear so by suggesting to our imaginations the hopes and enjoyments of man, or of some sentient being. Nor are the same instruments of emotion less influential even among those scenes which retain no visible memorial of man or his works. The thunder-riven mountain which swells from the side of the sequestered glen—the eternal snows which crown its summit, and nourish a thousand waterfalls—and the giant fragments, grey with age, which are strewn around its base:—rivers struggling through gloomy ravines—and cascades leaping from rock to rock, and wrestling and foaming like a maniac:—frowning precipices—and stupendous caverns—and overhanging woods—and cataracts whose echo among the mountains is mistaken for the roar of the thunder—all these are felt to be beautiful. But it is sympathy alone to which their beauty is attributable, and which lends them life and interest:—sympathy with the past or imaginary inhabitants of such a region, or with the dwellers in cities, to whose disquiet and feverish existence the moments spent in these romantic solitudes furnish so conspicuous a contrast—with lovers secluded from rude intrusion in these untenanted retreats, or the conception of the happiness of a life shut out from the guilt and turbulence of a sordid world. Add to these the mementos, which meet us at every step, of that Almighty Power which rent the mountain asunder, and poured out the rivers, and piled up the cliffs, and hollowed out the glens—and the record written on every rock, and whispered from every chasm, of the age and immutability of nature, compared with which the days of man are transient as the gleam of the lightning, and the accumulated records of his being but as a drop in the great ocean of infinitude. The beauty of softer and more tranquil scenes is traceable to the same elementary emotions. The moon threading her way among the clouds, or counting her attendant stars in the lake below—flowers glittering with dew-drops, as if weeping for the absence of the sun—the ripple of waters—the voice of the nightingale—or the eloquence of that silence, undisturbed by a single murmur, which speaks of the glories of a higher destiny, and comes upon the soul like strains of celestial music—these all owe their charms to our sympathy with man, or some other intelligence, or to some deep though imaginary feeling with which we invest the inanimate creation. Without the intervention of such a feeling, material objects could no more interest us than any promiscuous assemblage of colours on the pallet of a painter; and the vividness of the emotions of beauty they can raise will be just in the compound ratio of our power of discovering these real or imaginary relations, and the warmth of our social affections.

Should these loose and miscellaneous observations have made any impression in favour of the general theory, that impression will, we think, be materially strengthened by the consideration of that class of objects which are only productive of the emotion of beauty to those persons who have had an opportunity of associating them with some lively affection. Nothing can in fact furnish a more complete refutation of the doctrine, that beauty is an absolute quality, than is afforded by the phenomena of these accidental associations. If beauty were an inherent property, of objects like colour or weight, it is inconceivable that it should not be judged of similarly by the different nations of the world. Among a few individuals, indeed, we might imagine some organic defect to obtain—such as that which disenables some men to distinguish a red from a green colour, and which might incapacitate them from perceiving beauty, or convey to the mind a false sensation. But, we cannot imagine such a defect to prevail among whole nations, merely because they agree in thinking objects beautiful, of which other nations entertain an opposite opinion. On the theory of association, however, these anomalies become easily explicable; and constitute, in fact, a singular verification of its truth. If the emotion of beauty be the mere recognition of certain primary objects of affection—or rather we should say of a certain action of the mind, consequent on that recognition—material forms can appear beautiful only to those who have learned to interpret by them the existence of those affections, and will be the reverse of beautiful to those to whom they are indicative of an opposite expression. Female beauty, for example, being the reflection of youth and health, innocence, gaiety, and intelligence will naturally appear in that class of countenances which suggests those qualities to the spectator; and as the same outward appearances will not be indicative of the same qualities in the natives of Greece, as in those of Caffraria, the standard of beauty must necessarily vary in those countries. Thus, too, the inhabitants of particular countries will discern a beauty in its landscape, and a charm in its traditional poetry and music which foreigners cannot perceive, simply because they do not suggest to their minds the same feelings and recollections.

These accidental associations, however, are not confined to particular races of mankind. Almost every different profession, or individual, has some association which may give beauty in his eyes to an object which is indifferent to other spectators. A painter will discern beauty in certain difficult combination of tints—an architect in certain petty classical or feudal observances—an antiquary in corroded medals, and disfigured blocks of stone—a fop in a pair of moustachios, and a surgeon in objects which fill other minds with horror. The young and old—the learned and illiterate—the artizan and aristocrat—have all their peculiar associations, and the associations even of the same individual may vary from day to day, either by the gradual obliteration of former sensations, or the introduction of new objects of emotion.

The last class of relations we shall notice is, where the beauty of objects is the effect of some analogy, or fanciful similitude to the natural representatives of happiness or sensation. This relation is, perhaps, the most extended of any; and is, indeed, interwoven with the very structure of all forms of language. The expressions of poetry and metaphor are merely a continuous application of this relation. The spring and autumn, or morning and evening, so naturally suggest the periods of youth and decrepitude, that they are used synonymously with those expressions:—the murmurs of the rivulet give us the idea of gentleness and enjoyment—the roar of the cataract, of turbulence, or power, or pain—and the unruffled surface of the lake, of placidity and repose. Fragile and minute objects suggest the conception of gentleness, and delicacy, and objects bounded by flowing lines of freedom, elegance, and ease. Ornaments are said to be chaste or meretricious—colours to be grave or lively—sounds to be animating or mournful—pictures to be cheerful or melancholy—seas to be disturbed or tranquil—fires to rage—storms to threaten—and, in fact, every passion and affection of the mind to show itself in the various phenomena of the material world. These expressions show very clearly that we habitually confer sensation upon certain forms of matter, and indicate, we think, with equal sureness, that the interest we feel in material objects, is consequent altogether upon the mind and feeling we first confer upon them. The great secret, indeed, of the beauty of poetical diction lies in the connexion of common experiences and phenomena with objects of powerful emotion, by means of some relation undiscoverable to ordinary minds; and men will perceive more or less beauty in objects, in proportion as their fancy and experience can enable them to discover those attributes and affections in those objects which most powerfully engage our sympathies.

We cannot afford to multiply these illustrations, and have probably said enough to convince our more attentive readers, that the quality of beauty cannot be due to any fixed or physical property, but is the reflection merely of certain qualities of mind. It will be asked, however, why, if this be so, the reflected image differs in any respect from the original object? Why, if beauty be the reflection of love, joy, fear, hope, or veneration, it should be distinguishable in any way from those affections with which, nevertheless, it is never confounded? First, we may answer, because, though a reflection, it is not altogether a *faithful* reflection, but is tinged by the hues of the imagination—as the image reflected by a mirror of stained glass, may have acquired an altered complexion. Secondly, because the perception is not a *simple* one, but involves a certain exercise of the imagination, which alters the character of the product; and thirdly, because the perception is not fixed, and unvarying, as in the case of direct emotion, but comes upon the mind exalted or debased or perverted, by other associations, and the dimness and uncertainty of the original perception leave room for an exercise of the imagination, which is neither necessary nor possible in the case of less wavering impressions. Thus the emotions of pain, joy, or compassion are simple and direct, and come upon the mind alone; while beauty is a complex and indirect emotion, and comes upon the mind coloured or weakened by the reflection, and with its elements contending for a mastery they may consecutively for a short time obtain. The classes of direct and indirect emotion seem, in fact, to have a relation to each other, analogous to that which subsists between the knowledge bound up in a collection of enigmas, and that contained in an ordinary discourse. Both of these varieties of knowledge are discoverable, but by no means with equal facility by all minds; and while the one merely enlightens us by a revelation, the other at the same time stimulates the imagination to a discovery. It is this two-fold action of the mind, which probably for the most part renders our emotions of beauty in any degree different from those primary feelings of which they are substantially the reflection. The mind is busied in transmitting certain relations, at the same time that it is occupied in finding out what relations there are to be transmitted, and the pleasure consequent on the discovery of these relations is transmitted with the relations themselves, and often constitutes the most powerful element of the final emotion.

There are two varieties of beauty of which this theory does not, we think, furnish a full explanation—the beauty of colours and beauty of sounds. There are some colours which certainly appear more beautiful than others; and although there are no colours, perhaps, which would be beautiful in all situations, this, we think, is merely because the pleasure of which they are naturally productive, may be destroyed in some cases by an adventitious association. Mr. Alison, with whom, we believe, this theory of beauty originated, admits this case to be an exception to the general law; while others have attempted to explain it on the general principle of association, though, as we think, without success. The music which delights us by being exhilarating, solemn, or pathetic, manifestly does so by suggesting the emotions of joy, veneration, or sorrow; but the beauty of musical concords is not explicable on the same principle, inasmuch as those concords are generally pleasing, without suggesting any mental emotion. It appears to us, that the sensations excited by particular colours or concords are chiefly organic, and that the whole secret of the anomaly lies in classing those sensations under the generic epithet of beauty. They resemble the emotions due to the perception of beauty only in the single quality of being agreeable, and are no more entitled, we think, to be considered beautiful than pleasant odours, savoury food, and a thousand other things which are quite as agreeable, but which it would be absurd to pretend had any claim to the quality of beauty.

We have, we fear, by this time, nearly exhausted the patience of our readers, but must bespeak their toleration for a few minutes longer, while we make some such rough applications of the general theory to the case more immediately before us, as our remaining limits may permit. And we may in the first place observe, that it at once annihilates the doctrine, that there is any absolute and intrinsic beauty in the proportions of the several architectural orders. We have been so long accustomed to admire the architecture of ancient Greece, and to associate it with ideas of dignity and refinement, that its features have been invested by our imaginations, with a fictitious glory, and a wise and discriminating devotion has subsided into a blind idolatry. Unsatisfied with holding the Grecian proportions to be beautiful, we have proceeded to maintain that none others could be so, and have attributed some mystical and occult virtue to the combination of certain lengths and breadths in the idea that all others would end in barbarism and deformity. This preposterous dogma, the existence of very different proportions in Gothic architecture—which is, nevertheless, admitted to be beautiful—abundantly confutes, —though indeed, the existence of varying proportions in the Grecian orders themselves, constitutes to our mind a disproof which renders all others superfluous. But this theory by showing, not merely that there is no universality in these pretended standards, but that it is impossible there should be any, displays the doctrines of an empirical beauty in all its naked absurdity, and at once opens the path to architectural improvement, by the dissolution of those objects of pretended perfection, which for centuries have blocked it up.

The emotions which appear to arise naturally out of the contemplation of masterly architectural creations, or in other words, the qualities to which the condition of architectural beauty are properly due, are, 1st. Fitness, which suggests to the imagination human comfort and convenience. 2nd. Magnitude and difficulty, which naturally suggest to the mind ideas of power, and skill; and 3rd. Extension, richness, and variety, which suggest ideas of human dignity, intelligence, and enjoyment. With these primary emotions, others of a subsidiary character will generally intermingle, depending on the aspect of the decorations employed. Minute, flowing, and fragile decorations will naturally call up gay and airy imaginations; while those which are of larger features and a severer outline will give rise to emotions of a different character. Then, again, these *natural* emotions will generally be coloured, and in some cases obscured by emotions which are merely *accidental*, and which arise out of the peculiar associations of particular nations, sects, or individuals. Every nation will be disposed to prefer its own architecture to that of other nations, on the same principle that it prefers its own music, poetry, and landscape; while particular classes of men, will think particular styles of decoration more or less beautiful, just in the proportion in which those styles appeal to their prejudices or affections. Thus, for example, some persons in our own country will prefer the Gothic style of architecture, and others the Grecian, simply because the features of those styles are significant to different minds of different objects of emotion. To some, the Gothic will speak of the virtues and piety of our fathers—the miracles and mortification of saints—the godly humility of princes—the charities and labours of holy men—or it may be of the pomp and refinements of chivalry—the gallant exploits of knights —the music of hoary minstrels, and the revelries, competency, and enjoyments of the poor; while in other imaginations the prevailing images called up will be those of the riot of an intolerant priesthood—the cruelties of prelacy and superstition—the fires of Smithfield—the groans of the martyrs— the contests of revengeful chieftains—the thraldom of the lowly, and tyranny of the rich,—and in short of blood, barbarism, and desolation. Among those familiar with Grecian history, the emotions to which the Grecian architecture will give rise will probably be equally conflicting—just, indeed, as the spectator is disposed to view, or able to look upon the dark or sunny side of the picture: while those again who know nothing of history, either classical or feudal, and have, therefore, never learnt to read historical events, and conditions, in the characteristics of particular styles, will be free from the disturbing influence of these accidental associations and be, therefore, so far in a better condition for arriving at an unprejudiced judgment. This, indeed, amounts to saying, that the illiterate are better qualified to judge of architectural compositions than those whose education enables them to discover a wider range of relations; and paradoxical as the assertion may appear, it is nevertheless, we believe, nearly correct, that in every art appealing to the imagination, popular opinion will more nearly approach to the standard of unperverted truth, than the dicta of virtuosi and professors. The theory we have been considering, in fact, very clearly shows that there is no taste which deserves to be called bad except in so far as it is peculiar, and is founded upon narrow and accidental associations, instead of upon such as are universal and indestructible. Every particular class or profession, will generally form some technical association in which the great bulk of mankind cannot participate, and it is because these technical associations are wanting in uninstructed spectators, or mutually redress one another in the public mind, that the verdict pronounced by popular opinion relative to works of art, is entitled to such weight and deference. Those architects who affect a contempt for public opinion, only show how ignorant they are of the true principles of the art in which they pretend to be proficients, and how strong that egotism must be which makes them mistake their own casual associations for natural and necessary relations.

It would appear, then, that there are two senses in which a thing may be beautiful;—the one in which by virtue of some particular association, it will excite the emotion of beauty in the mind of a particular spectator, and the other in which it possesses some quality which will naturally make it appear beautiful to all men in all ages. An object which conveys the sense of beauty to any particular person *is* beautiful to him, and all tastes are therefore equally just, so far as the individual himself is concerned. But it does not therefore follow that all tastes are equally desirable; and if we aspire to be creators of beauty for the admiration of others, we must take care that the elements we employ are such as are the common and natural signs of agreeable emotion. In the exercise of this function, we must subdue all our personal associations and address ourselves to the interesting impressions of ordinary minds, and that taste will, in this case, deserve to be called vitiated, which satisfies the associations of only a particular caste or individual, or erects the creations of an eccentric fancy into an idol for universal adoration.

It would appear to be another consequence of our deductions, that an infinite number of new architectural orders may be invented, some of them probably of much greater beauty than any which have been hitherto devised. We do not, however, think that any new architectural order, bearing a near resemblance to any of the existing orders, would be tolerated, though a new order of no near resemblance to the existing orders might, we think, become popular at once. The features of the existing orders, have become so familiar to the mind, that any trivial alteration upon them would excite ideas of mutilation and deformity—much on the same principle as a human countenance with an additional or deficient nose, or eye, would awaken emotions of disgust; whereas by an entirely new order, no more disgust would be excited than by the perception of an entirely different animal. A horse, and a tiger are both beautiful animals, yet a horse with a tiger's head we should not reckon beautiful; simply because the combination is uncommon, and carries to our minds the idea of suffering and disaster. A new variety of animal, however, differing from all we had previously seen would excite sensations no more painful, than were those excited by the animals with which we are now familiar when we saw them first; and the analogies subsisting between the animate and inanimate creation, make this fundamental law equally operative among inanimate objects. We, therefore, think that any extension of our resources of architectural embellishment must be brought about by the invention of new orders, not by the alteration of those whose features have become indelibly fixed upon the popular mind. Eventually, perhaps, such alterations may succeed; but if attempted at the outset of our career of improvement, they would inevitably, we think, be a failure; not from any absolute incongruity, or unfitness in the combinations themselves, but because the original objects by shining through those new combinations would convey to the mind ideas of violence, and monstrosity.

It further appears, we think, to be the result of our inquiries, that the Gothic is not the style of architecture *naturally* best calculated for religious edifices. It is hallowed, it is true, in our imaginations by solemn associations, and in most minds familiar with its applications, we believe will be productive of solemn impressions. But this effect is merely an accidental one, and is much akin to the gloom a white colour produces on the minds of the Chinese, among whom it is used as a sign of mourning. The natural effect, we think, of the minute, fragile, and elegant components of the more florid Gothic, is to move the imagination to gaiety; and, indeed, such a structure as Henry the Seventh's Chapel, with its flying buttress and airy frost-work, appears to us much fitter for a theatre than a church. The emotions which church architecture should naturally inspire,—if it should inspire any,—are those of veneration, humility, and awe; and no species of architecture will so certainly inspire these emotions as that which deals in stupendous representations of living beings. This the ancient Egyptians well understood; and we can scarcely conceive anything better calculated than the architecture of some of their temples for quelling the spirit of the worshipper, and banishing the arrogance and pride of heart which stand in the way of devotional feeling. Among their avenues of sphinxes, and halls supported by images of human beings a hundred feet high, the spectator collapsed to the dimensions of an insect, and acquired a lesson more powerful than a thousand homilies, of his own frailty and insignificance. We do not for a moment pretend that there is not much in the Egyptian architecture that naturally excites rather ridicule and disgust than solemnity and veneration. The anatomical imperfection of the different representations of living objects for example,—the grotesque hieroglyphics, and many other peculiarities, are all far from pleasing; and we are perfectly confident that any attempt to revive the true Egyptian architecture in the present day could not succeed. But we think the employment of similar instruments of emotion, without any more regard to those details which more particularly give the Egyptian complexion than if they had never existed, could not fail, under judicious treatment, to be eminently popular and successful. It would of course be applicable only to particular kinds of edifices—chiefly churches—and should neither imitate ancient peculiarities, nor neglect any of the aids afforded by the skill and science of the present time. The sculptures should be as true representations of natural objects as the present state of skill can produce, and those objects should be such as are agreeable in themselves, and as, at the same time, are possessed of sensation. To give an example of this architecture—a dome, twice the size of St. Paul's, supported by human figures as tall as the Monument—that would be one variety; and the most sluggish imagination may conceive something of the sublimity of such a structure, and how pale and puny even our most boasted edifices would become in the comparison. The expense, indeed, of such an architecture, is an obvious objection; but, with the means of facilitating productions the useful arts now afford, in the case of objects which are merely repetitions of one another, the expense might be made so moderate as to deprive this objection of most of its weight. We must observe, too, that we do not participate in the antipathies of some architects relative to artificial stone, and other elements of a more perishable variety of construction; and, indeed, with the exception of a few particular cases, we think it a reckless extravagance to rear buildings calculated to last till the final conflagration, and which, ten to one, will be burned or demolished in the lapse of a few centuries. A more perishable species of building would be better both for architecture and architects. It would make the introduction of improvements a work of less hesitation, at the same time that it would afford a greater number of opportunities for their introduction; and the saving in the first cost might, at compound interest, generally suffice to reproduce the building in a comparatively short period. Upon this subject, however, we are unable at present to enlarge, and must content ourselves with observing, that, taking into account the aids afforded by modern art to architectural progress, it seems practicable to invent a number of architectural orders which, without being much, if at all, more expensive than those now in use, will be either much more sublime, much more magnificent, or much more elegant and airy. Of these varieties of architectural embellishment, we shall be presumptuous enough, on an early occasion, to furnish some examples, provided that these rude and general hints have not intermediately had the effect of awakening to the work of invention some of those more accomplished practitioners whose more active fancy and more sufficing powers of execution may enable them to achieve such combinations as would both meet with greater attention and more eminently deserve it.

These, then, are some of the consequences which flow from that train of investigation in which we have so long detained our readers, and which we distinguish by the name of the Philosophy of Architecture. To some persons we are prepared to expect it will appear a mere waste-heap of metaphysical refinements; but the larger proportion will probably agree with us in thinking that it constitutes the essence of architectural knowledge, and lies at the root of architectural proficiency. While freeing the fancy from those restraints imposed by a tyrant precedent, it defines clearly the limits within which its flights must be restrained, where the aim is not to please ourselves, but to please human nature; and stands equally opposed to the insipidity of classical sublimations and the vulgarities of a gaudy magnificence. By overturning the notion that art can be empirical, it gives, we think, a most powerful impulse to architectural progress, while the relation it establishes with human sympathies gives a new complexion to architectural art such as cannot fail, we think, to inflame the imaginations, and quicken the sensibilities, of the less apathetic of its votaries. This, however, it may be contended, though a very important task, ought to have devolved upon other hands, being foreign to the professed objects of a work devoted to the operative arts. To the first point of this objection we have only to reply, that the hands which would have executed the task better appear to have been unwilling to undertake it; and, to the second, that it appears to us founded on a mistaken estimate of the position really due to those arts known by the name of operative, as well as to a fallacious conception of the intellectual stature of the persons habitually employed on them. It is with the *artizans* that art has ever originated: it was born in the workshops of Athens, and resuscitated in the workshops of Italy; and if it be destined to experience another renovation, it will be in the workshop, we are confident, where the revival will take place. Finally, we may observe, the philosophy of architecture displays the true value of that species of architecture criticism which praises and blames empirically—which erects the personal associations of the critic into the dignity of natural laws, and which reveals, in the acerbity and intolerance of its decisions, the outpourings of a frozen heart and mortified vanity. All men have some peculiar associations, and, therefore, some peculiar ideas of beauty; and these they have every right to maintain so long as they do not attempt to force them on the acceptance of others. But those who work for universal admiration must be careful to deal with those objects only which address themselves to universal associations, and which are the perpetual concomitants in all minds of deep and agreeable emotion.

Art. II.—PARTICULARS OF RAILWAY WAGONS.

Specification for a Merchandize Wagon on the London and South Western Railway.

The wagon to be constructed of English oak of the best quality, free from sap and all other defects, and of the following scantling: viz., sides, when finished, 12ft. long, 7½in. by 4½in., and well secured at their intersections by bosom-pieces, and securely bolted together: the buffer-ends of the wagon sides to be increased to 13½in. deep by 7in. wide, and well secured by bolts, and further by a wrought-iron hoop 1in. by 3⅛in. The ends of the two long bolts to be reduced and screwed to take a ⅝in. nut, which bolts are to pass through. The lower or bottom sides to be 2in. wide and ⅝in. thick. By this way, should the timber shrink at all, the buffer-end can be tightened up at any time. The hoop must have two strong wood screws on each side; the space between the cross bearers and the top of the wagon side to be filled up with bridging pieces of oak, flush with the top side of bearer, and 2½in. thick, and the centre line of bridging of the same dimensions, to which the draw-bar must be secured, in addition to the bolt passing through the cross bearer. The wagon sides and cross bearers to be well secured by wrought-iron knees, and four $\frac{9}{16}$in. bolts to each, to go through the sides, and also through the bearer. When the frame is complete, and put out of winding, the axle-guards are to be put on perfectly square with each other, 5ft. 4in. from centre to centre on the side, and of the proper breadth between, so that the legs will drop fairly into the slots or grooves in the axle-box, when it is placed in the journals of the axles. They must also be set equidistant from a line running through the centre of the wagon, or line of traction. The axle-guards must be made of the best hammered scrap-iron ¾in. thick, with the fibre of the iron running in the direction of the leg, and shut up with one weld in the top; to be planed out to 8¾in. wide between the legs, and weigh 52lbs. each, and put on to the wagon with four ¾ bolts, with countersunk heads, which are to be flush with the inside face of the guard. To preserve the fibre of the wood in the wagon side, and prevent rupture arising from wear and tear, the four bolts in the axle-guard must not be in the same line between the first and second and the third and fourth bolts. Put two $\frac{9}{16}$in. bolts through the depth of the sides, tightly screwed up. The two sides to be of the best Memel or Baltic timber; the other end, at which the door opens, to be of English oak; the sides to be 14in. deep, 3in. thick on the bottom edge, and 2¼in. on the top; the two end curbs to be 2¼in. deep (those sitting on the floor of the wagon), and of the same dimensions as the sides; the side curb must be well secured to the cross bearer with wrought-iron knees on each bearer, with two $\frac{9}{16}$in. bolts going through the curb, and two through the bearer, and further secured by a vertical bolt through the bearer, and ploughed on the top to receive a hoop-iron tongue. The floor of the wagon to be covered with the best Memel flooring, 11in. wide, and 1¾in. thick, to be held down with three wood screws 3¼in. long (No. 26), in the breadth of each balk on the cross bearers. The curb to be notched at the corners, and secured with wrought-iron corner-plates 2¼in. × $\frac{5}{16}$in. thick, which are to be fixed with ⅜in. rivets and ½in. screw-bolts, the head being kept inside. Three standing-posts on each side of the wagon, and two on each end, 3in. wide by 2½in. thick at the bottom end, and tapering to 2in. thick at the top. These posts to be bolted with two ⅝in. bolts each to the curb, with the heads inside, and tenanted on the top end to receive the top curb, which is to be morticed down on the former, and grooved out ⅝in. wide and ⅝in. deep, to receive the tongue of the sheeting on the top side of one end, which is to be 1½in. thick, bevel jointed on the edge, and ploughed to receive a hoop-iron tongue 1¾in. wide by ⅛in. thick. The sheeting to be riveted to the standing-post with ⅜in. rivets, with three in the breadth of each board, and the sides and one end dovetailed. One end of the wagon is made to open with folding doors 1⅝in. thick, ploughed and tongued, having the boards running vertical: they are afterwards drawn together with four ⅜in. iron rivets or bolts passing through the door. There is a piece of circular oak curb on the top of each door, ploughed and morticed to receive the tenons on the end of the sheeting-boards. This curb piece is similar in scantling and finish to that on the sides, which is 4in. × 3, rounded on the top to save the tarpauling from being cut.

The doors are then hung with two sufficient hinges to each door, of the best iron and workmanship, to the standing side-boards of oak on each side, which are 12in. wide and 2in. thick. These standing-boards are tongued on the outside, to fill the groove in the inside of sheeting, and secured by four ⅜in. bolts or rivets, and two strong wood screws in each board, and riveted on countersunk plates, and tenoned into bottom curb, and rebated to receive the inside post (which post is secured by a knee), to the same thickness of the door, and tenoned to receive the oak curb on the top, as specified before. These doors have no wood cross-bars, therefore the strap-hinges must be strong.

The wagon to be mounted on the best wrought-iron wheels and axles (such as those manufactured by Messrs. Losh, Wilson, and Bell, or others equally good, but must be approved of by the Company's Engineer), having the tires 5in. wide; the axles to be of the best hammered iron, 3¼in. diameter between the wheels. That part which passes through the nave of the wheel to be 3⅝in. in diameter, and 4½in. long, well and truly turned to a template, which will be furnished by the Company for the purpose. The wheel to be bored out to fit the axle well, and keyed on with a steel key 1⅛in. wide and ⅝in. thick, properly fitted, and well driven home.

The axle-boxes (for which the Company will supply a pattern) to be fitted up with gun-metal bearings, well and truly bored out and fitted up: the springs well secured with spring fasteners, the plane of the spring being at right angles with the line of axis of the axle; the springs to be 3ft. 2in. long; to have eleven plates of best spring steel 3in. by ¼in. broad (weighing not less than 66lbs.), well made and tempered, and to be severely tested before they are put in use. The wagon is to have a good lever-brake, well keyed to its axle: the end of the lever to be open, to admit a man's hand, and to have an improved brake-guard, of which the Company will furnish a pattern. The draw-bar must be made strong: at the eyes or ends the section of any part must not be less than 1½in. diameter, and of the best iron and workmanship; the part between to be 2½in. by ⅝in. thick. The holes which receive the bolts which pass through the cross-bearers to be cut lengthwise by a chisel, and then swelled out to the size of the bolts by a round punch. The draw-bar to have three other smaller holes punched between each of the former, for the purpose of being spiked or bolted to the centre line of oak bridging, which is fitted in between the cross-bearers.

Each wagon to be furnished with a good sufficient connecting-chain, with a hook at one end and a shackle at the other, the shackle being made fast to the draw-bar. There must be four hooks on each side, and three on each end of the wagon, screwed into the under side of the curb, for the purpose of making fast the tarpauling cloths.

Manchester and Leeds Goods Wagons.

The following are the dimensions of a goods' wagon on this railway:—

The length to be 14ft. 6in. from outside to outside, and 7′ 2″ wide from outside to outside; the soles to be 6′ 6″ from outside to outside, 12in. deep and 3in. thick; to be of the best English oak, free from knots and shakes; to have two tenons at each end, 1½in. thick and 1in. long; two end cross-bars to be 7′ 6″ long, 1′ 4″ deep, and 3″ thick, to be lightened out between the buffers and draw-hook to 11½in.; four diagonal pieces of best English oak to go from corner to corner, 3in. wide by 4in. deep, to be screwed at each end to the end bar with corner-plates and bolts; and, in the centre, two blocks of wood fitted in on each side, and secured by two bolts through the whole; and four short ones, of best English oak, to go from centre bar to centre of end bars; to be lapped into the sole of the wagon and the end bar, and secured with corner plate, and bolts to the same, and to be half lapped where they cross each other, and secured with a plate at each crossing, with four bolts in each, and to be flush with the top of the sole of the wagon to take the bottom floor in; the end cross-bars to be framed 4in. above the top of the sole, or flush on the bottom side: one cross-bar in the centre, 3in. thick by 4in. deep, to be tenoned into the soles, and take the corner plates of the diagonal pieces: the centre cross-bar to be secured to each sole with a plate 3in. wide and ½in. thick, which is to form strong corner-plates at each end, to be secured to the sole of the wagon with two bolts at each end, and six through the cross-bar: two pieces best English oak to be framed into the end cross-bars, 4in. deep and 3in. thick, and to have one plate, iron, 2in. wide by ¼in. thick, to continue round the top of the wagon, to be secured with corner plates at each end, let in and fastened with strong screws, and to take the ends of the bottom boards, which are to be rabbeted into the above two side pieces, and secured to the same with strong screws: the flooring to consist of three pieces of ash, one at each end and one in the centre, 2in. thick and 12in. wide; and the space between each of the above to be made up of poplar boards 1½in. thick, and put together with white lead, and well secured to the frame-work with strong screws: the axle-guards to be ¾in. thick, and the same pattern as those fixed on the Company's wagons, and to be 7′ from centre to centre; 5′ 10″in. between (or suitable for wheels, the bearings being 6′ 3″in. from C to C′), to be secured to the soles with four ¾in. bolts, and to have a plate of iron ¼in. thick, 1′ 10″in. long, 3in. wide outside the sole; and take the four bolts, and to be exact in placing them on correctly. Four buffer-blocks of elm, and to be 13in. long, both ends to be 12in. diameter, and 9in. diameter in C to be turned, and a rope capping fixed on each buffer-block, with nine square-headed screws; the whole to be fixed on with four ½in. bolts in each; from centre to centre of each to be 5′ 10″ and 7″ from the bottom of the end bars: the springs to consist of fifteen plates, 3in. wide by ¼in. thick, to have 7in. compass, and 3ft. 6in. long; the short plate to be 10in. long; the steel to be of the best quality, properly tempered, and put together in a workmanlike manner, and well tested before put under: the draw-springs to have thirteen plates in, of ¼in. steel, and 3in. wide, and 3ft. 1in. long, and 6in. compass, to be fitted up with a socket to take the draw-hook, to be secured in the same with one cotter, 1in. wide, ¼in. thick, and fixed on the under side of the framework, and secured to the same with one iron crab, to be made of the best iron, 1½in. wide by ⅝in. thick, and a space left in the centre for the socket of the draw-spring to work in, 12in. long and 2⅜in. wide; the draw-hooks and connecting rods to be the same in all respects as in the pattern wagon No. 25: the short draw-rod to be 2ft. 9in. long from the back-side of the hook, to pass through the end cross-bar, and take a stud, which is to be fixed on a short cross-bar with two ½in. bolts: the short cross-bar is to be framed into the diagonal pieces 1′ 6″in. from inside of the end bar: the draw-rods to be 1½in. in the square part, and 1′ 6″in. long; the round part that passes through the stud to be 1′ 3″in. long, and 1¼in. diameter: the two connecting-rods that take the eye of the draw-spring to be ¾in. round, iron, and secured to the draw-rod with bolts taking a socket, and the socket to be fixed on the draw-rod with one ½in. square-headed set-pin going through both: the long draw-rod that takes the socket of the draw-spring to be 1′ 3″in. long in the square part, and 1⅛″in. diameter in the round part; one plate to be on each cross-bar for the draw-rod to pass through, 7in. long and 6in. wide, ¾in. thick in the middle, and ⅜in. on the outer edge; the same to be secured through the end bar, two ½in. bolts to take the corner plate of the diagonal pieces: the crib-rails to be of the best English oak, 4′in. high from the top of the bottom side to the top of the crib-rail: to have five rails in each side, ¾in. wide by 1¼in. thick; to be secured to the uprights with two ¼in. rivets through each crossing: to have three uprights, of the best English oak, 2¾in. square; the bottom end of each to have one iron hook to take the eye of the side of the wagon, and to come up each side of the uprights 6in., and bolted with two ½in. bolts, and three eyes fixed on each side of the wagon, to take the hooks. The outside corner plates to form a socket and eye to take the crib-rails, and fixed on with four ½in. bolts, and continued down the end cross-bar, and secured to the same with one ½in. bolt, taking the clam that goes round the end of the cross-bar with one screw and nut, and to have two pieces of oak fixed on diagonally from the centre upright to the end: the end rails to have three uprights of best English oak, and to fit into three square sockets 3in. wide and 2½in. deep; to be secured inside the end bar with nuts, and not riveted. The crib-rails made to fit any of the wagons. The crib-rails to be secured at the corners with three chains, and drop-pins, to be long enough to admit the side crib-rail, to extend 8in. each to chains 5′ 6″in. long each, to be fixed to the centre upright of crib-rail with one ring-bolt, fastened to each upright with two ⅜in. bolts; one chain to have four rings, one at each end; the others 6in. from each other: the other chain to have a T or X link, so as to pass through the links on the other chain, to fasten them together, and four ring-bolts secured under each side, at an equal distance, to secure the sheet or covering when the crib-rails are not in use. The wheels to be of the best description of malleable iron; the naves to be 10in. in diameter; the tires to be of the best bowling-iron, 5in. wide and 1½in. thick on the edge. The axles to be of the best description of hammered iron; the length to be 6′ 3″ (centre of bearings); the bearings to be 5in. long and 2⅝in. diameter: the part that passes through them to drive up against ⅛in. shoulder. The part of axle between the wheels to be 3½in. diameter; the bearings to be case-hardened, and the wheels to be staked firmly and correctly on the axles with one steel key ⅝in. diameter; and when finished, the wheels to be 5′ 4″in. from outside to outside of each tyre, the height of which is to be 3′ 1″in.; the draw-chains to be 1′ 8″in. long from end bar to inside of hook; the links to be of ⅝in. iron, with a strong hook at the end to be fastened through the end cross-bar with an eye-bolt ¾in., and secured with a strong nut; each side to have a break of the same construction as on the pattern wagon No. 25. Axle-boxes and brass steps, all to be the same description as those under the Company's wagons; the brass steps to be well fitted to the journal and into the axle-boxes: eight cast roller-boxes to take the ends of the bearing-springs—six fastened on the under side of sole with four strong screws 1in. each, and two to take the brake, secured with two ½in. bolts in each. The whole of the materials to be of a superior quality and of the best kind; to be put together with white lead, and subject to the approval of any one the Company may appoint previous to painting. To have two coats of light lead colour, and two coats of yellow paint, and the iron work black.

Art. III.—MAUDSLAY AND FIELD'S MARINE ENGINE BOILERS.

(*As made for the West India Mail Steamers "Trent" and "Medway."*)

Plate XI. represents the boilers introduced by Messrs. Maudslay and Co. into the West India mail steamers, and which are, indeed, the common form of boiler employed by that firm. The engines of the West India mail steamers are of 400 horses power; and for the supply of those engines with steam, *four* boilers are requisite, each such as is shown in fig. 5. For 200 horse-power engines *two* such boilers are used. The only difference, therefore, in the boilers of 200 horse and 400 horse-power engines is in the number of boilers employed. In the one case they are of course fired only from the one end, and in the other case from both ends.

The drawing so completely explains itself, that it is unnecessary to append to it any lengthened description. A A A, figs. 1, 2, and 5, are the furnaces. B B B, the fire-bridges, which are not brick, but water-bridges, and slanted a little on the top side to facilitate the escape of the steam. E E, figs. 2 and 4, the take-up or passage for the ascent of the smoke from the lower to the upper tier of flues. The ash-pit, it will be remarked, has a little inclination, so that any water which might enter there will run out. The chimney is not shown, from want of room.

Art. IV.—CAUSES AND REMEDY OF THE PRESENT DISTRESS.

The present condition of this country cannot fail, we think, to be a source of disquietude to all who wish it well. With an unprecedented prostration of commerce—agricultural produce without a market—capital without a means of investment—poor laws most onerous upon one class of society and insufficient for the wants of another—there coexists a ferment and disaffection in the popular mind which aggravates all these calamities, and which, unless soothed by the application of adequate remedies, must necessarily end in mischief. The immediate cause of this state of things has, no doubt, been the depressed state of trade, and will, of course, be ameliorated as trade revives: but we question whether any revival in trade would now affect the political sentiments of the labouring classes, or be able to still the troubled waters. The hearts of the people have been embittered by suffering and a deep sense of wrong: and the apathy shown in some quarters—the provocation given in others—and the criminal designs of many eager only to win the people's affections, have worked them up into a state without precedent in our history, and which demands and must obtain the surrender of some of that power which particular classes have used for their own aggrandisement, without regard to the rights or welfare of others. Against such a state of public feeling it would be something more mad than madness to oppose only those checks and severities which end in a greater irritation. The power of the law must, no doubt, be maintained, and riots and illegal assemblages put down by force. But if no allowance be made for the miseries in which tumult may have originated—if no disposition be shown to assuage the sufferings of the people by timely concession and indulgence—if their complaints be repressed by insult and menaces, and the redress of their real grievances denied because they may be associated with some that are imaginary—if the intemperance of a famishing multitude be alone remembered against them and their cry for bread be answered by the roar of the cannon—it is not difficult to foretel the issue, nor to see which side must prevail in that dreadful contest, of which physical force is made the arbiter. To us it appears that it is the interest of every party to treat this question fairly, and that to do justice is the only antidote against having injustice done.

The first thing is to satisfy ourselves of the reality of that distress of which our manufacturing districts are the theatre; or rather which has now extended itself over every class of the labouring population. This is so appalling that the mind naturally recoils from its contemplation, and seeks shelter in incredulity from so painful and terrible a spectacle. Yet it is no phantom, but a sad and stern reality; and no person content to give his belief on this subject on a weight of evidence which would carry conviction in any other inquiry can fail, we think, to arrive at the conclusion that the condition of our labouring poor is unprecedented in misery, and is in fact very much as has been represented by those who have endeavoured to convey to more incredulous minds some conception of its intensity. This distress is of itself, no doubt, calculated to dispose the multitude to murmur, yet if brought about by natural causes, or any visitation of Providence—by bad seasons—an impoverished soil—fire, war, or deluge—the calamity would be borne with meekness. But when the conviction exists that it is the consequence altogether of class legislation—of an utter recklessness on the part of the rich as to the condition of the poor, feelings are called up which, if they do not find a vent in the achievement of some salutary change, will subside into a sullen and rancorous hatred, which must accumulate until it issues in rebellion. In *thāt* state of the popular mind all concessions and ameliorations will be unacceptable, which by taking away the grounds of discontent might arrest the approaching earthquake; and the latent rebel will look on with a savage exultation while wrong is heaped upon wrong, and oppression piled upon oppression in the hope that they will speedily overwhelm the fabric in which his sufferings are supposed to have had their origin. This dangerous feeling has extended itself to a most alarming degree in the present day. An extraordinary separation of the lower classes of society from the middle and upper classes is daily becoming more visible. It is not now a contest between political parties that we have to deal with, but a contest between different classes of society—between wealth and poverty—between the small number of the rich and the great volume of the labouring poor. The natural event of such a contest is a civil war, in which we are persuaded it must end if all reasonable ground of discontent be not promptly taken away; and if such a war be once lighted up, the destruction of our constitution and afterwards, perhaps, of our liberties is, to our apprehension, inevitable. Whatever might be the immediate result of that contest, its ultimate effect would still be the same: if the populace were defeated in their attempt by the opposition of a military force, they would only be roused to a fiercer resentment, and a deeper hatred, which would sooner or later break out into still more ruinous disorders. For a time, perhaps, a government might succeed in maintaining an uneasy existence in opposition to the public will, but in this country at least such a state of things could not continue long; and we do not believe that in any country is an example to be found of a government maintaining a stable position by leaguing with a section of the people against the far greater number of them. Such a combination would call up jealousies and contentions in which the ruling power would inevitably fall, and the violence of the fall and the severity of the disasters would just be in the proportion of the previous exasperation.

All parties however, we believe, profess themselves most anxious to mitigate the present distress, but find an excuse for not attempting the performance of something calculated to have that effect in the variety and incongruity of the schemes brought forward as remedies. Now it appears to us that this is a mere excuse—a sophistical and unworthy excuse for real indifference. If legislators were in the condition of the starving poor, would they be content with such a reason? If parliament waits until all people agree as to what is best to be done they will wait for ever, and what will become of the pauper in the meanwhile? The fact is, if our present legislators cannot determine as to what should be done, they should retire, and let persons settle the point who are able to come to some decision. It is not so essential that we should have the best remedy, as, that we should have *some* remedy: it would at least contribute to quiet people's minds to find that something was being attempted for their relief: but to sit still and do nothing, merely, because all men do not agree as to what should be done, is the sure way to lend an irresistible weight to those who will be content only with great organic changes, and maintain, that there is no other remedy but what such changes bring for the evils with which our population is afflicted. Those who urge the incompatibility of the aims and doctrines of the several political sections of the people as a reason for attending to the applications of none of them, forget that all these creeds, however seemingly incongruous, are phases merely of one great fundamental truth—the sufferings of the poor. The Chartist does not embrace the doctrines of that section of the community out of any admiration of its abstract principles—for there are a thousand abstract principles quite as admirable, about which he cares nothing—but he believes that measure, whether justly or otherwise, to be a remedy for evils which he knows to be real, and in proportion to the severity of those evils will be the vehemence of his endeavours to obtain the object which he imagines to be the specific for them all. The very conflicting demands, therefore, of different political sects are merely applications in different languages for the same thing. The Anti-Corn Law advocate is anxious for the repeal of the corn law, because he thinks it would directly conduce to the happiness of the people; the Chartist is opposed to the repeal of the corn law, because he conceives its repeal would so appease the people that they would afterwards be insufficiently strong to work out their own deliverance: but the doctrines and objects of these adverse sects equally show, that the popular miseries are great, and demand a remedy,—that, unless abated by prompt and sincere measures, they will show themselves in shapes of the most dangerous and diverse character,—and eventually, perhaps, may assume such a form as to become inconsistent with the preservation of monarchy itself.

We cannot afford, however, to dwell longer upon these topics, and must now proceed to indicate as briefly as we can the manner in which the existing distress has arisen. The war which followed the French Revolution, displayed to all the world the extraordinary wealth, and resources of England; those resources were attributed to her manufacturing proficiency, and every nation, consequently, became anxious to obtain a share in that branch of industry. This, naturally made foreign nations anxious to manufacture at least for themselves; and this injudicious desire on their part to divert their capital from the cultivation of the soil which constituted their natural wealth, was afterwards turned into an act of necessity by our impolitic legislation. The imposition of the Corn Laws prevented those countries of which corn was the natural product, from taking their manufactured goods from us, and made it compulsory in them to become manufacturers both to their own loss and to ours. Our market was, consequently, restricted to those countries of which the produce was not corn; such for example, as the United States, of which the produce is cotton and tobacco, and in those countries it continued to extend, at a rate so rapid as to make us in some degree insensible to the loss of those markets, from which our own impolitic laws had excluded us. Although our market however was great, it was necessarily unstable in the proportion of the fewness of the countries it embraced; inasmuch, as any shock the prosperity of those countries might experience would affect us in the proportion of the extent of our transactions with it, or rather in the proportion our transactions with it bore to our transactions altogether. Six or seven years ago, the United States, one of our best customers, began to become embarrassed seriously; the cotton crop had been bad, the money laid out in an infinite number of public works, had failed to realize a profitable return, and that country was consequently unable to take the usual proportion of our manufactures. This was the first blow, and it was followed up by the unfortunate issue of several of our own railway and other projects, in which a vast amount of money became locked up without yielding any profitable return. Concurrently with these impoverishing causes, several bad harvests succeeded one another, which made it necessary to buy corn in foreign countries, and these countries being already supplied with manufactures of their own, would not take our manufactures in exchange. Add to all this, that British manufacturers had begun to find that it was more profitable for them to build and work a mill in a foreign country, where food, and consequently wages were lower than in England, where wages were high because provisions were dear; and the produce of foreign looms, wrought by English capital, has consequently been underselling us in the foreign market. The consequence of all this is, that we must either remove those restrictive laws, which make subsistence dear, or cease to be a manufacturing nation; and if we cease to be a manufacturing nation, we shall soon, if we do not cease to be a nation altogether, be obliged at least to come down from that high eminence from which we have looked upon the ends of the world. It is our machinery that has fought our battles, and which keeps us from sinking at once under the enormous debt, bequeathed to us by a former age; and if that prop be taken away, we must sink at once under our accumulated greatness and corruptions.

These cursory remarks, are probably sufficient to show that the present distress of the country is due chiefly to the restrictive laws which have been imposed by an assemblage of land-owners, in the mistaken hope that their personal interest would be benefited by them. This we do not believe has been the case; and, indeed it is, we think, the general effect of monopolies, to injure those as well in whose favour they are instituted, as those on whom they press. They take away all that stimulus to exertion and improvement which constitutes the vitality of commerce, and make men sit down in apathy, content with the efficacy of their fictitious aids in carrying them on to fortune. The consequence is, that those trades and transactions which are defended by a monopoly have scarcely ever thriven;—they become delicate and weakly as hot-house plants, and no exclusion, however complete, can shield them from the occasional blasts of the world without, or the blight which follows so rude an application. The silk trade, for example, was for centuries afflicted by a monopoly, and the paroxysms of its distress followed one another in rapid succession; but since the year 1826, when the monopoly was abolished, it has thriven quite as well as the other branches of our industry, which before it did not. We believe the abolition of the Corn Law will be productive of similarly beneficial effects to the land-owners themselves. The proof of this, however, belongs to another part of the subject.

Our present restrictive laws, then, appear to have operated in bringing upon us the distress which at present weighs so heavily upon the country; 1st. By depriving us of the market of corn-growing countries:—2nd. By distributing the manufactures we produce among few instead of among many countries, thereby depriving our trade of the steadiness it would have if the number of its outlets were greater, and the calibre of each of them less; 3rd. By encouraging the emigration of capital to foreign countries, and converting those countries into formidable competitors; 4th. By making our supply of food so entirely dependent upon our own harvests, and thereby making either the price of provisions, or the current of exchange, or both so seriously dependent upon our atmospherical vicissitudes. If these be the causes of the disease under which we are suffering, the remedy is obvious enough, and consists merely in the removal of those commercial restrictions which have brought our commerce to the brink of ruin. Hostile tariffs should be abolished, whether there is reciprocity or not, and colonization so largely and liberally encouraged, that the surplus population of this country may speedily become large consumers of our manufactures in foreign lands. These are the physical means of ameliorating the condition of our artizans, and the moral and intellectual means should not be neglected. But physical means must precede all others, and it is altogether vain to imagine that a multitude perishing of famine, will be content to be put off with a hornbook or a psalter. It may be all very true, that this should not be the case, but it *will* be the case notwithstanding; and all our attempts at reformation will be futile, if we attempt to deal with men as they ought to be, instead of as they really are.

It has been alleged by some political economists, as well as imagined by a large number of our artizans, that the present distress is due in a great measure to the introduction of an improved machinery, by which one man is enabled to do the work of a great number. It is easy however, we think, to show that this doctrine is erroneous, and indeed the fact appears to be that but for the reduction in cost accomplished by our improved machinery, we could neither sell our fabrics in foreign markets, nor keep our waste lands under cultivation. The truth of the first of these propositions is too obvious to require proof: that of the second, though not so evident, perhaps, is we think quite as demonstrable. If, for example, a piece of ground produce 1,000 bushels of corn, and if of this quantity one-half be spent in seed and the other half in supplying food, implements, and clothing to the labourers employed upon it, that piece of ground must go out of cultivation for the simple reason that it yields no profit. But, if by means of improved machinery, the expense of clothing and implements be materially lowered, the ground will be cultivated, because the amount of this reduction will go as profit to the cultivator. Any reduction, therefore, in the cost of implements and clothing will increase the farmer's profit, and a reduction in the cost of his seed and in the food of his labourers will increase it still more. Taking these circumstances into account, we do not believe that the condition of the farmer or landowner would be the least injured by the repeal of the Corn Law, especially if reference be had to the greatly increased demand for agricultural produce that must then take place.

Into the objections brought against the manufacturing system, we do not think it necessary to enter further than to say that our mob of artizans is neither so ignorant, so immoral, nor so seditious as other mobs, only a little better dressed perhaps, give them credit for being; and even were they all of these, whose is the blame? Our large towns are not necessarily seats of crime and disease, though often from the negligence of those in authority, it happens that they are so; and if our working population are sometimes guilty of raising tumults—goaded into frenzy by their sufferings and oppressions—with whom lies the blame of those formidable outbreaks, and who ought to suffer by the convictions they bring? The errors of our artizans, we admit, have been many and great, but they have all had their origin in the still greater errors of the classes above them. Our gentry think that universal suffrage is a very bad thing, and perhaps they are right; but does not the earnest demand for that measure carry something of an evidence, at least, that the rights of the unrepresented classes of the community have been utterly disregarded? The demand for vote by ballot, again, has sprung out of the corruption brought to light by every election; and the proposal of annual parliaments is simply and solely the effect of septennial Parliaments utterly neglecting their duty. However blameable the excesses of our labouring population may be, they are the reflection merely of the vices and corruptions of those by whom they are blamed the most loudly, and tell rather of the profligacy of the rich than of the weakness and wickedness of the poor. It is to the misconduct of our legislators that nearly all our present misfortunes are attributable; our country is still the same; its soil and its climate still crown the labours of the husbandman with their accustomed plenty; its waters still bear our ships upon their bosom; and our mines are unexhausted, and our artizans equal to what they ever were in numbers, energy, and skill. These are the elements of our greatness; they still remain to us, and if wisely administered cannot fail to produce their former effect: and, dreadful as our situation undoubtedly is, there is nothing in it which appals us but the want of wisdom in our rulers.

Art. V.—THE MANAGEMENT OF HIGHWAYS.

Remarks on the Management of Highways; with Observations on the various Principles of Road-making. By Edward Bagot, A.M., Civil Engineer and mineral surveyor. Llanelly, 1843.

The roads of England are, with a few exceptions, by no means answerable the progress that nation has made in the science of locomotion, or, indeed to its achievements in any of the useful arts. The roads of Scotland, especially those constructed by Mr. Telford, are greatly superior; and the same may be said of the great roads of France, some of which have claims to a very high position as engineering works; and whether in direction, inclinations, cross section, or surface, are not exceeded by any roads in any country. Our railway system has of course greatly diminished the importance of our roads as a means of internal communication; still they are very important elements of our national prosperity and deserving our serious attention.

The causes of the imperfect state of our roads is traceable to the defective constitution of our road trusts established by the legislature under the provisions of a turnpike act. These, long ago, were found to be most defective in their operation: the management was committed to a number of country gentlemen, who were named as commissioners; and as they were paid nothing, a vast number were usually appointed. These persons who possessed no qualification in road-making, except that of happening to live in the vicinity of one, were entrusted with works requiring skill and science for their execution; and at their tumultuous meetings nothing was generally done except perhaps undoing the work of the meeting preceding. Dukes and doctors, farmers, shopkeepers, and tailors, were mixed up together in one motley group; and the end of the whole was, that some busy meddling forward person gained and carried the sway: the more respectable members retired in disgust, and the administration fell into the hands of those who had never any interest in the matter, except so far as it might be made to serve the interests of their friends or of themselves.

The employment of Mr. Telford in the formation of the Highland roads at once showed the advantages of a different system, and the sense of the benefits of that system were still further strengthened by the satisfactory result of the Holyhead roads also made under his direction: nevertheless, the management of the roads in England have never been put upon a satisfactory footing; and persons are employed to levy and expend money for the repair of our roads who are perfectly unqualified for either function. We leave the exposition of some of these evils to Mr. Bagot.

> " Officers are, year after year, appointed to assess, collect, and expend a highway rate, without ability for the first, firmness for the second, or judgment for the third—demand upon their time; no remuneration is allowed them, the usual return being the ill-will of those whom duty has compelled them to come in contact with. What, therefore, can be expected from such a system? How can integrity or honest intentions continue proof against such hostility on the one hand, and temptation on the other? Will men calmly lose their time for nothing? though they profess it, yet will they, or do they do it? Decidedly not; in some shape or other they must and do receive a compensation; if men of property, they improve, to add to their comforts—if in business, their business flourishes by a confluence of purchasers. Their friends they benefit, while they return it. Lost time and trouble must be paid for, and especially the forfeited good-will of numerous rate-payers."

There is much truth, we fear, in this picture, and the following also appears to us to be true to nature:—

> " His ignorance of prices obliges him to hire all labourers by the day; and masons so employed have been known to lay flags that thus cost the parish at least double what by contract they could have been done for, and perhaps, in the end, requiring to be re-laid. He scrapes the roads when, possibly, they do not need it, and when the very act proves injurious to the metal; or should he do it at a *proper* time, he perchance forgets to remove or make use of the heaps so collected, which are speedily worked back upon the road, and a double expense is involved in their subsequent withdrawal; or it may be, he neglects to scrape them altogether, although it is a work so absolutely necessary, since nothing is more injurious to a road than mud, as it confines the rain, which quickly wears the surface. Overlooking this very important point, he wastes a vast quantity of metal by admixture with this mud, which is speedily ground down by the wheels of carriages, when assisted by wet—there being no more powerful auxiliary for the 'grinding process' than water; a fact that may be instanced from its use by glass-cutters and statuaries, both of whom *require* its agency with the particles of the substances on which they act."

There are two very essential points which deserve attention in road making, which, though not immediately connected with the formation of the road itself, are essential to its durability and efficiency. The first is draining, without which no road can acquire the requisite firmness in wet situations; and the other is airing, or, in other words, the removal of all objects out of proximity to the road which might interfere with evaporation from its surface. If the road be kept always in a wet state, from whatever cause, its wear will be very rapid, and its condition always bad.

The best way of removing the water caused by land-springs appears to be by running a drain on each side of the road, on the inner or field side of the hedges, and at a level of at least four feet below the surface of the road at the centre. The locality of the springs must then be intersected with mitre drains filled with rubble-stone, and which must of course open into the side or open drains by suitable orifices, with an adequate number of outlets, or rather inlets, for the surface water. The ellipticity of the cross section of roads must, of course, vary with circumstances. A fall of six inches at fifteen feet from the centre, is a common and a good descent, but in the case of hills the curvature must be greater, else the water will run down the middle of the road, and form it into gullies.

The most important part, however, of road-making, or the part, at least, which it is most important should be generally understood, is the proper formation of the surface. To this end good materials must be selected, and those materials must be properly applied. Upon the subject of materials we concur in Mr. Bagot's remarks, which we here extract:—

> " Rocks combining *hardness* and *toughness*, produce the best road metal. Hence *brittle* materials, though frequently *hard* also, are objectionable. The igneous or primitive rocks, Greenstone, Basalt, and Granite, are best adapted for roads. Greenstone, as a metal, stands unrivalled, except by Basalt. Being composed of but two minerals, Augite Horneblende, a peculiarly hard and tough substance, and felspar, which is generally the least component, and tolerably strong in this rock, it may fairly be called homogeneous, a desirable point in road-stone. Hence it surpasses syenite, rendered brittle by its quartz; as also the Granites, inferior by their quartz and mica. The darker sorts of Granite are the best; the felspar and mica of the light-coloured being more prone to decompose from the chemical action of the air, and the mechanical effect of water. Bombay and Guernsey Granites are good, also the Whinstones of Northumberland, and Whin-boulders on many coasts—the Greenstone of Salisbury Craigs, at Edinburgh, with some Limestones of the carboniferous and transition series. In general, those rocks that exhibit the strongest union or cohesion of particles, when inch-cubes of them are submitted to the blow of a hammer, may be safely relied on for durability and strength—a test adopted amongst many to prove the stone to be used in the new houses of Parliament now building. The Oolites and Sandstones are evidently unfit for road metal, though circumstances may oblige the latter to be used. In such cases, the more crystalline and compact they are the better. The rapidity with which they disintegrate with wet, renders it necessary to secure them, if possible, a dry bed."

There are two modes of distributing the materials, both of which have their advocates. The first is that of Mr. McAdam, and consists, as is well known, of the simple application of broken stone to the surface, until a depth of concreted metal has been obtained sufficient to give the road the requisite strength. The other plan is that of Mr. Telford, and consists in covering the surface with larger stones, laid evenly and regularly by hand, preparatory to the application of the broken stone. This latter plan is now the one generally preferred by proficient road-makers, but is, of course, applicable only in the case of new roads. The two plans appear to be of about the same expense; the trouble of laying the surface with the larger stones, in Mr. Telford's plan, being compensated by the necessity of breaking the stones in the other case, and of using, at the same time, nothing but road metal of the best description.

We cannot find room to say anything further on this subject, and must here conclude these few cursory remarks. We think the management of our roads should be taken out of the hands of parish authorities, and given to the care of some central board—such, for example, as the board of Excise. There would be some chance then that good engineers and surveyors would be appointed, and that the roads would be well made and well managed—conditions not to be looked for in the present mode of their administration.

ART. VI.—OUR CLUB. No. IV.

The music of that silent hour
When pearls are hung on ev'ry tree;
The thoughts that oft in darkness lower,
And gayest tones of revelry.
NEW SONG.

ACT I.

SCENE—*The Club-room.*

Present—SIR JONAH, LARDNER, SCALPEL, *and* JEFFREY.

JEFFREY. I trust no one knows who the real culprits are.

SIR JONAH. No. No one has the least conception; or, rather, those who have any conception at all have a very mistaken one.

JEFFREY. So much the better. It is pleasant to be able to laugh at the critics without being suspected.

Enter MONTGOMERY *and* GRAY.

GRAY. I dinna think it was unceevil in the least, but quite the contrary. I'll put up to the company. The gentleman that brocht this note I axed into the kitchen to warm himsel—for there's a gran' fire in the kitchen—an' I telt Gairdner forbye to mind an' gie the gentleman a drap yill, or a drap o' the mountain dew, if he likit it better; an' if he wanted a toast made for the yill, to be sure—

MONTGOMERY. Pooh! he'll accept none of your toasts. Gentlemen do not generally like to be made guests of the kitchen. But the thing is now done—

SIR JONAH. The note.

MONTGOMERY. Give it to me. I'll read. (*Reads.*)

" To the Gentlemen composing the ‸alledged Artizan Club, number 00, Cypher-street, London.

" Mr. Vairy presents his compliments to the ‸several gentlemen composing the ‸aforesaid Artizan Club, and begs to express the gratification he has derived from the perusal of ‸the published numbers of their talented work ‸entituled the Artizan (to be published monthly). Mr. Vairy perceives by the article ‸entituled 'Our Club' (in the aforesaid magazine) that ‸occasional meetings of the said Club are holden (from time to time) for ‸the purpose of discussing ‸and elucidating various mechanical questions, as well as questions of a more spiritual kind."

SCALPEL (*aside.*) The causes of double vision and other optical illusions.

MONTGOMERY (*continues.*) " And Mr. Vairy will be gratified by being granted the *entrée* to those ‸aforesaid meetings, believing that he will derive much gratification ‸and edification therefrom."

MONTGOMERY. A most curiously interpolated epistle.

GRAY. If I had kent he was a lawyer, I would not have asked him into the kitchen. I canna bide lawyers—present company o' coorse excepted.

SIR JONAH. Tell Gardiner to show the gentleman in—he is no lawyer. Of the kitchen indignity, we must of course pretend to know nothing: it would only make it worse.

MONTGOMERY. The fame of our Glenlivet seems to have gone abroad over the earth.

(*Enter* MR. VAIRY, *ushered by* GARDINER.)

SIR JONAH. We are glad, sir, to make your acquaintance; and trust we may be frequently favoured by your visits.

MR. VAIRY. The fact is, gentlemen, I am much attached to mechanical discussion, and am always desirous of being where it is going on. And really there are very few I can talk to on the subject; for most of them confound mechanical force with forcible motion, and know nothing of the *vis viva.* Now Mr. Watt understood the question of *vis viva* very well. At the engine at the Albion Mills this was shown very clearly; for those mills were in motion day and night, and after a short time walked away altogether. Mr. Woolf, too, understood the *vis viva;* for, at Messrs. Meux (now Messrs. Reid's) brewery, he pumped two feet of sand into the liquor-backs in a very brief time: plainly showing that the sand had been marvellously quickened. Indeed, the well he sunk there was a most affectionate well: it fell in love with an old well in the vicinity, and, after a brief courtship, the two were duly united. There were no 'miserly' proceedings in that case; but—

(*Here the door opening suddenly, nearly oversetteth* MR. VAIRY, *and putteth an end to his dissertation, while* GARDINER *announces the* CHAIRMAN OF THE BUILDERS' *Society.*)

SIR JONAH. Since we are all here, now we had better adjourn to the supper-room. I will lead the way.

GRAY. Noo, Mister Jaffray, yo shall cleek wi' me. O, but you're a clever chiel, an' bonnie ye'll be in the een o' posterity.—(*Exeunt.*)

ACT II.

SCENE—*The Supper-room.*

SIR JONAH. To obviate trouble, I have had each of the dishes labelled in legible characters, so that we may dispense with the bill of fare.

GRAY. It's a capital invention: it was jist impossible to ken ae thing frae anither. I'll tak my stan' afore the cockie leckie.

SIR JONAH. This boar's head is a present from our friend Professor Agassiz.

JEFFREY. And promises to do him credit. Yes, you may give me an eye.

GRAY. The man that's howkin' the snaw—weel, weel, it's a queer ploy. Mr. Varry, will I help you to some o' the cockie leekie?

MR. VAIRY. No, those Indian dishes do not suit my palate.

GRAY. Indian dishes! Div ye think I'd recommend ony o' thae pagan stews? Na, na—cockie leekie 's a true apostolic dish. Jist dook your spoon in an' taste it. Is na 't gran'? O, it aye puts me in min' o' John Knox.

LARDNER. I'll trouble you for a slice of that tongue.

GRAY. Na, there's nae gettin' at the tongue at a'. Gairdner, ye shouldna put sae mony flooers on the dishes. It's no a skep o' bees ye hae to provide for. The tongue 's a perfeck boukay.

MONTGOMERY. A Cupid among the roses. Doctor, that's dangerous fare.

LARDNER. N'importe. I'm steeled.

GRAY. *You 're* stealed? Na, the common opinion is, that it 's quite the ither way—

SIR JONAH. Shall I give you some of this boar's head, Alexis?

GRAY. No the noo—I hae cockie leekie. But, then, I dinna min' the haivers o' ony body. An', as I was sayin'—

Montgomery. Scotchmen can never relinquish their affection for the three B's.

Gray. Whatna B's are thae ?

Montgomery. The Brose, the Bannocks, and the Brimstone.

Gray. It's weel for ye that it's supper time, an' that cockie is na guid when cauld. To put a calumny like that on the best and bonniest country that ever saw the face o' day.—But—the cockie leekie——

(*Conversation here becomes inaudible, and nothing is heard but a low whutter, interrupted by occasional monosyllables.*)

Sir Jonah (*to Gardiner.*) You may now remove ; place the decanters in the perambulators, and the kettle with his attendant spirits before Mr. Montgomery.

Scalpel. I vote that Montgomery favours us with a song.

Gray. Na. I hae na forgot the three B's.

Omnes. A song ! a song ! a song !

Montgomery. I must try to make the song appease you. (*Sings.*)

Air—" Alice Gray."

1.

He 's all that fancy paints a friend,
As active as sincere;
Austere when parasites commend,
And steadfast when they veer.
Untutor'd in the wiles of art,
Ambitionless to sway—
Oh, he 's the monarch of my heart
My honest Alick Gray.

2.

I 've bask'd in hope's delusive gleam,
I 've drunk of sorrow's rill,
And friends have flown like fancy's dream,
Or mists upon the hill.
But oh, when other hearts were chill,
And eyes were turn'd away,
One heart there was burn'd brighter still—
The heart of Alick Gray.

3.

In vain—in vain—upon my head
The storm has spent its rage,
And now my place is with the dead—
My rest from pilgrimage.
And though the sorrows of my doom
Unheeded die away,
One tear will tremble o'er my tomb—
The tear of Alick Gray.

(*Montgomery faints. A great commotion.*)

Gray. He 's deed ! he 's deed ! Rin for the doctor—fetch water—water ; an' hartshorn ; the—the—the—oh dear, oh dear !

Sir Jonah. Oh, it's nothing so very alarming ; the effect, merely, of a strong imagination,—his pulse is beating still,—just a passing faintness.

Scalpel. Loosen his cravat and give him a sip of brandy.

Mr. Vairy. I recollect Mr. Watt once fainted, in the same way, just after he had been telling a ghost story, and Mr. Woolf when—

Lardner. The brandy revives him. Come, come, waken up.

Montgomery. If this be the land of forgetfulness, it is not an unpleasant land. And you here too ? so quickly ? what—all ?

Jeffrey. O yes, the same earthquake took us all down at once, and what is more, very kindly brought the bottles with us : so here drink off a glass in acknowledgment of such great civility.

Montgomery. Ah ! I see 't is but a dream ; well, I can only beg a thousand pardons for falling asleep in such company. I trust I did not snore.

Gray. But ye 're sure you 're waukin noo, are ye ? Weel, weel, get up from the grund an' let us talk o' something else.

Sir Jonah. Perhaps Scalpel you'd favour us with some lively ditty.

Scalpel. With all my heart ; but I think the animation would be greater if we were all to sing a verse in rotation.

Chairman of the Builders. I never sung a verse of a song in my life.

Scalpel. And therefore you should now begin. I vote that Montgomery shall sound the key note, and that every one shall talk on a verse in his turn.

Sir Jonah. Well then, begin.

Montgomery (*sings*)—

Air—" Gentle Zitella."

1.

Montgomery. Gaily for Jeffrey,
Strike the guitar,
Poesy's referee,
Literature's star.
Lardner. Music's enfeoffer he
Pours from the string,
Tones soft as zephyry,
Breathings of Spring.
Scalpel. Mail'd now in sapphire he
Marshals to war ;
Wits chosen gaffer, aye,
Pedantry's bar.

2.

Chairman of Builders. Vainly for Jeffrey
Breathes the guitar ;
Gog is not deafer, he
Ponders afar.
Sir Jonah. Musing for ever, eh ?
Clouds on thy brow ;
Laugh for ye—quaff for ye,
Live only now.
Jeffrey. Yea, but—quoth Jeffrey,
Hush the guitar ;
Any old heifer wry
Moans better far.

(*Here* Gray *seizes upon a fiddle on the side table.*)

3.

Gray. Waukin for Jeffrey,
Joy's stirrin viol—
Dees now the reverie,
Sawtan's espial.
Vairy. Primed are ye ? Every ?
Brimful your bowls,
Health to the Jeffrey,
King of our souls.
Omnes. Hurrah for Jeffrey,
Yes, three times three,
Niffer we, whiffer ye,
Riotously.

The Curtain falls.

Art. VII.—CAMPAIGNAC ON STEAM NAVIGATION.

De L'état actuel de la Navigation par La Vapeur et des Améliorations dont les Navires et Appareils à vapeur marines sont susceptibles ; par A. Campaignac, Chevalier des ordres royaux de la Legion d'Honneur et de Francois I. des Deux-Siciles, ex-Ingénieur des constructions navales, &c. &c.—Paris : L. Mathias, 4to, 1842.

This work is a very excellent one of its kind, although it is very different from what we would have been inclined to anticipate from M. Campaignac, either in his character of a Frenchman or a practical engineer. We, in England, are accustomed to regard ourselves as the leaders in most of the practical departments of engineering, while we are generally ready to allow to the French the merit of successfully elucidating the mathematical theory, which, in John Bull's more practical disposition, is often hid under the guise of common sense. If from M. Campaignac's country we might have expected to find in his work a considerable deal of mathematical disquisition, we were also inclined, from his profession, to expect that considerable pains would be taken by him to lay down rules for the guidance of engineers engaged in the building of marine engines and steam-ships. A judicious blending of these two characters might have produced a work on this subject both highly interesting and, at this moment, much wanted ; but the work before us can hardly be said to have any claims to either characteristics. It is, as we have said, excellent of its class, but it belongs to a lower class—the class of popular treatises. As such, it is one of the best we have met with. It possesses the grand qualification for general readers, of being nearly entirely free from technical mathematics, while it at the same time enters so fully into the subject as to give the reader a very complete idea of the various objects to be accomplished, the many difficulties to be overcome, and the proportionately numerous mechanical contrivances that are brought into play in the present advanced state of steam navigation. The author has initiated his readers as deeply into all the mysteries of engineering as he could well do, without making them actual engineers ; and, what is still more to his credit, he has extricated them from the labyrinth with a wonderfully clear idea impressed on their minds of the road by which they travelled. In another respect M. Campaignac is not what we should have expected. Most popular authors on such subjects are uniform encomiasts of innovation : they generally look on all plans that have never been tried with a highly favourable eye ; and appear to write on the principle, that all that has not been proved to be bad must be considered as perfect. With the aid of this very charitable doctrine they build on the foundation of experience the most delightful superstructures of future improvement, the only objection to which is, that they exist only in the imagination. The author of this volume, on the other hand, is quite a matter of fact gentleman, much addicted to sticking by present good plans till others are very clearly *proved* to be better. He is what may be called a conservative in mechanics, who sees in novelty only a ground of distrust;—he likes better to wait and see what the English will make of a new scheme, than spend French money in the prosecution of *experiments*, the majority of which always have, and probably always will, end in nothing. Accordingly, that part of the work devoted to *Améliorations* is the most meagre and least interesting of the whole.

The work is divided into four chapters. The first treats of the general theory of steam vessels, including the discussion of the subjects of resistance to motion in fluids,—proportion of power to tonnage,—action of paddle-wheels, &c. Chapter 2 contains a complete account of the steam engine as applied to steam navigation. Chapter 3 furnishes a similar disquisition on the subject of steam ships,—and the last chapter is devoted to improvements, none of which can, we think, possess much novelty in the eyes of an English reader, while some plans which are spoken of with great distrust by the author have already been proved by extended experience to be entitled to at least very favourable consideration.

These four chapters occupy about 115 pages, the rest of the volume extending in all to 327 pages, being made up of notes. The plan of adding copious notes to a volume such as this, is, in many respects, a good one. It enables the author to introduce many detached pieces of information and observations on various topics that could not well be introduced into the text, without deranging the plan, and giving a disjointed air to the whole. But, while we think well of the plan, we think our author has, in the present case, carried it somewhat too far. He has included in his notes a large quantity of matter which ought to have been incorporated in the text; and this has been done apparently for no other reason, than that he has thus been enabled to save himself the trouble of arranging and reducing the amorphous mass of notes into a symmetrical whole. Notwithstanding this, however, which we cannot but think a defect, some of the best things in the book are to be found in the notes.

There are several errors of fact into which M. Campaignac has fallen, and in which, if our limits had been greater, we might have undertaken to correct him. As it is, we must be content with mentioning that one in which he attributes the introduction of the plan of making slide-valves with cover or lap to Messrs. Maudslay and Field. The fact is, that plan was invented and introduced by Boulton and Watt; and we have the drawing before us of an engine made by that celebrated firm in the year 1805, the valve of which has a considerable quantity of overlap. M. Campaignac supposes that Mr. Miller obtained his acquaintance with the plan of making valves with lap from Messrs. Maudslay and Field; but we think it much more likely that both obtained their knowledge on this subject from Soho. Mr. Miller was a pupil of Messrs. Boulton and Watt, where it is likely he became acquainted with this in common with the other Soho improvements: but, however this may be, we are at least certain that Mr. Miller made engines with lap on the valves as long ago as 1817, (when he first began to make engines,) and that he has adhered to the plan ever since. There are other instances in which Messrs. Maudslay are alleged to have been copied by different persons, when no such copying, we believe, has taken place; the practice of *both* parties having been probably derived from Soho.

Before closing our remarks on this volume, it may not be amiss to advert, in a very few words, to the French claim to the invention of the steam engine as here set forth; and we do this not for the purpose of confuting it, but merely with the view of explaining in what it consists. When our countrymen know what a Frenchman means by the invention of the steam engine, we think they will not be so niggardly as to refuse them the praise due to that invention in the sense Frenchmen understand it.

M. Campaignac says:—

"In the year 1615, Salomon de Caus, a French mechanician, was the first to *adopt the idea* of employing the elastic force of aqueous vapour." "In 1690, another Frenchman, Denis Papin, *proposed* to make it act through the medium of a piston moving in a cylinder, and to combine it with the property that is possessed by vapour of being condensed by cold." "In 1698, an Englishman, Savery, in constructing a machine to raise water, which bears his name, was the first to realise the idea of Salomon de Caus."

The first two of the above extracts comprise the whole list of French inventors as given by M. Campaignac; and from them it appears, that the one *adopted the idea* of using steam power, and the other added to that the additional *idea* of a piston. We do not think it is worth entering into the discussion of whether any Englishman had previously had similar ideas floating in his brain. We can easily afford the *Grand Nation* the whole glory of so very ideal a discovery, especially when they themselves are so polite as to admit that an Englishman was the first to *make* a steam engine.

M. Campaignac proceeds:—

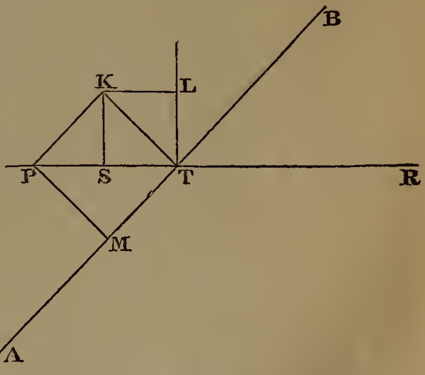
"The researches of one of our most illustrious accademicians have proved, with mathematical demonstration, that France had the first part in the invention of a moving power, by the aid of which our age has accomplished such marvels. But here especially the old proverb is verified,—*Le Français invente, et l'Anglais perfectionne.*"—This proverb might be freely rendered thus—*The leading ideas of some very useful English inventions have sometimes flitted across the imagination of a Frenchman without the least practical result.*

Art. VIII.—THE AERIAL PROJECT'S REQUIEM.

The "Ariel" has now been a month's wonder; and, if it has not yet attained so exalted a position in the realms of ether as the Comet, it has at least pretty fairly divided with its long-tailed compeer the attention of the public and the press during the past month. The parallel may extend yet farther; for the "Ariel," like the Comet, seems fast retreating to the obscurity whence it so suddenly emerged. We would not have thought it necessary to disturb its retreat, or in any measure to retard it in its progress to that state of oblivion for which it seems best adapted, had we not felt it necessary once more briefly to advert to the subject for the purpose of correcting a mistake in our former Number, which, in the hurry of preparing for publication, had escaped our vigilance. The mistake to which we allude was in its nature venial, though important in amount. We made 1760 *feet* in a mile, in place of as many *yards*. Fortunately, the mistake itself was so very obvious, that it could scarcely mislead any one; and its bearing on the argument was of equally easy perception. Its correction simply strengthens the argument against the possibility of the Aerial's flying three-fold. We might, perhaps with propriety, here drop the subject until the "Ariel" shall have made her first trip, when, of course, we will be vigilant chroniclers of the triumphs of scientific skill, and humble apologists for our own deficient foresight; but as, during the past month, some critics have appeared, who endeavour to extract some sort of a presumption in favour of the aerial scheme, from the contrariety of the results arrived at by the various writers against it, we hope our readers will stretch their patience a little, while we endeavour, very briefly, to deprive it even of this very flimsy dependence.

The argument to which we have alluded may be stated thus:—A numerous band of objectors have appeared to show, by *unerring* calculations, that the "Ariel" cannot fly: but as these calculations, almost all, give very different results, it seems probable that none of their concoctors know much about the matter, and that, after all, Mr. Henson is the only person who sees to the bottom of the subject. Now it appears to us that this sort of argument, like a double-edged sword, cuts two ways; for, the variety of opinion among writers—some of whom, at least, must be admitted to know a little of science—seems to show that this particular branch of natural philosophy is not yet very well understood, at least not sufficiently well to be made the subject of accurate *à priori* calculation. In these circumstances, what must we think of Mr. Henson, who has, on such doubtful authority, set up a flying machine (in procinct) as well as an Aerial Transit Company, and has introduced both to the notice of the House of Commons. He has done all this, too, without making a single experiment, so far as is known, to improve our present imperfect acquaintance with the subject. Surely all this is more calculated to produce an impression (we hope an erroneous one) that this gentleman is either a dreamy schemer or an accomplished quack, than that *he* is right, and a host of others wrong.

The uncertainty in most of the calculations on this subject, arises from our imperfect knowledge of the amount of the resistance opposed by the atmosphere to differently-shaped bodies passing through it at various velocities. We shall therefore show that, independently of any supposition whatever on this point—no matter *what* may be the resistance of the atmosphere, or what its law of variation—the aerial, or any other carriage on the same principles, cannot possibly keep afloat. As was explained in our last Number, the immense canvass plane, or kite, is proposed to be driven through the air in an inclined position, such as A B; and the oblique action of the air on this large surface is intended to keep the whole machine from falling.



The horizontal line R T will here represent the direction in which the air strikes the plane A B; but as the plane can only oppose a resistance in a direction perpendicular to its surface, the force of impact of the wind must be decomposed into two forces, one of which will be perpendicular to A B, the other parallel to it. Thus, suppose that the line T P represents the force of impact of the air, both in quantity and direction, it will be equal (by the well-known principles of the resolution of forces) to two forces, K T, perpendicular to A B, and T M coincident with it. The force K T, again, may be decomposed into two other forces, T L and T S. T L, being perpendicular to T R, evidently represents that part of the force of impact of the air that is exerted in sustaining the weight of the machine. Now, from the construction, it is evident that for any inclination whatever of A B,* T L must always be very considerably less than T P. In other words, the *sustaining* power must always be less than the propelling power. The propelling power, indeed, will generally be many times greater than the sustaining power; but, for the sake of argument, suppose them to be equal. If we remember rightly, Mr. Henson makes the whole machine weigh 3000lbs.; and let us suppose that it goes at the moderate flying velocity of 60 miles per hour, or 5280 feet per minute. The pressure opposed to its motion we have, for the sake of argument, supposed to be no more than the weight of the machine, or 3000lbs. From this we get $\frac{5280 \times 3000}{33,000} = 480$, which is the number of horses' power that must be flying in the air, compressed into a weight of 3000lbs., or about $1\frac{1}{3}$ton, which, besides the engine, must include fuel, water, carriage, wings, passengers, and the whole paraphernalia of the aerial steam carriage "Ariel."

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* That no one may entertain any doubt of this, it may be thus proved:—Let θ = angle of inclination of A B to T R, that is, to the angle B T R. The angle B T R is equal to the angle K P T, and the angle K T P is its complement. Hence, $KT = PT \times \sin\theta$. But the angle K T L is equal to θ, and $TL = KT \times \cos\theta$. Hence, $TL = PT \times \sin\theta\cos\theta$. As the sine multiplied by the cosine must always be less than one, T L must always be less than P T.

Be it remembered, that this conclusion is true, or, rather, far within the mark, whether the resistance opposed by the atmosphere to the motion of the kite be one ton or one ounce per square foot. With this we take leave of the "Ariel;" and hope to see it soon restored to that nothingness from which it would never have risen but for the gullibility of newspaper editors and gouty old gentlemen with more money than brains.

ART. IX.—REFORM OF OUR METRICAL AND MONETARY STANDARDS.

In the fire which consumed the houses of Parliament, the standard weights and measures, which had been prepared some years previously, were destroyed; and a commission was therefore appointed to consider of the steps necessary for their restoration. This commission consisted of some of the most eminent philosophers of the day; and the report they drew up is one of much interest and value. It appears, however, never to have excited any very high degree of attention in the public mind, notwithstanding the question is one of the utmost importance to nearly every class of the community. We propose to lay before our readers a few remarks upon this subject, in the hope that they will prove acceptable and useful.

There are two ways of so establishing a system of measures, that, if destroyed, it is conceivable they may be re-produced. The first is, by making them some multiple or sub-multiple of a natural standard which cannot change: the next, by establishing some determinate relation between them and such a natural standard. The primary unit of the French metrical system is the mètre, which is defined to be a ten millionth part of a quadrant of the meridian. The English primary unit is the standard yard, the relative length of which, as compared with that of a pendulum vibrating seconds, in the latitude of London, at the level of the sea, has been ascertained with great care by Capt. Kater. To fix the length of the French mètre, it was of course necessary to measure an arc of the meridian; and this task was executed by Delambre, and some other distinguished persons, with great precaution. Within these few years, however, it has been found that the measurements of the French philosophers, or rather, perhaps, the calculations founded upon them, are not correct; and, that between the mètre in use and the mètre of definition, there is a difference of $\frac{1}{5590}$ of the whole. Capt. Kater's determination of the length of the pendulum, too, turns out to have been incorrect, and the yard of definition is consequently about $\frac{1}{500}$ of an inch too long. The scientific determination of our weights and measures of content has turned out equally unfortunate. With the thermometer at 62, and barometer at 30, the weight of a cubic inch of distilled water is taken at 252.458 grains; and the Act of Parliament passed at the introduction of the imperial standards, specifies that a pound troy shall have the relation to a cubic inch of water which 5760 has to 252.458. Later experiments, however, have thrown doubts upon the weight of a cubic inch of water; and it appears probable that the troy pound of definition differs from the troy pound in actual use, to the extent of a ten or twelve thousandth part of the whole weight.

These discrepancies show how uncertain all those measures must be which *depend* on some natural standard, the relation to which it is always difficult to ascertain. It may be very well to ascertain the relation our unit has to such natural standard, but to *found* a unit upon any natural standard involves the supposition, that all the previous scientific determinations have been *absolutely perfect*; and this is a condition hardly to be expected in any age. The measures which have been destroyed, cannot now be reconstructed from the definition; and of what use can be the definition in such a case? It appears to us the much more sensible plan, to take the primary units, or one of them, as we find them, and to have a great number of standard units measures constructed, the same in all respects; which may be distributed in different places of safety, both in London and in the country. If one or two of these standards were lost or burned, the rest would probably remain, and no difficulty could therefore arise from the casualties one set only of weights or measures are inevitably exposed to. The administration of our weights and measures should, indeed, be an entirely practical one; it should reject all philosophical refinements, of which the sole purpose is to establish a useless generality, and should seek only to achieve the greatest possible amount of good with the least inconvenience to the public. The ancient associations of the people must not be wantonly violated; nor must it be forgotten, that it is only within certain limits that a government *can* enforce the laws it may think fit to make. And if alterations *be* ventured upon, they should be such only as will render accounts and computations more clear, simple, and easy, not such as will gratify philosophical fancies.

A very remarkable instance of the baneful effects of rash legislation upon such subjects as the present, is afforded by the substitution of the Imperial gallon for the measures previously in use. The reason for the introduction of this measure assigned was, that it weighed exactly ten pounds of distilled water at the temperature of 62°. It seems doubtful, however, whether this is exactly true; and even if it be so, in what respect does a gallon of 10lbs. possess a superiority over one of 9 or 11lbs.? The experiment at least of ascertaining the capacity of the gallon by the means indicated, is one of such nicety as to be impracticable to ordinary persons:—it is a philosophical experiment solely, and probably has not been tried a dozen times since the introduction of the Imperial measures. The introduction of those measures occasioned a vast deal of inconvenience, loss, and discontent; and achieved at the same time no one useful purpose.

We do not anticipate that any serious alteration in our system of weights and measures, or at least in the primary units of them, will speedily take place; but in our monetary system a change seems not unlikely, and would be productive, we think, of beneficial effects. It would be a great convenience if our coinage and that of foreign countries were made identical in value; and even if that could not be done, it would be a great improvement to introduce the decimal system more completely into our own monetary transactions. The commissioners we have adverted to, at the commencement of the present article, have gone into this question, and they recommend that the sovereign should be retained as the primary unit of our coinage, but that the value of our smaller coins should be so altered as to make our monetary system more strictly decimal. The following are the alterations they propose.

1st. The introduction of a new silver coin of the value of two shillings, to be called a Victorine, Florin, or Rupee.

2nd. A silver, copper, or mixed coin of $2\frac{2}{5}$ths of a penny, to be called a Cent.

3rd. A copper coin of the value of $\frac{24}{25}$ths of a farthing, to be called a Millet.

The half-sovereign, the crown, and the shilling would still circulate as at present, but all the rest of the coins would be called in as being irreconcileable with the decimal system it would be the object of this new plan to introduce.

There is one objection which occurs to us as attaching to this scheme: we allude to the loss our labouring classes would sustain by the introduction of any new species of smaller coin of a rather higher value than those already in use. A coin of the value of $2\frac{2}{5}$ths of a penny would almost inevitably pass for two pence, and the expenditure of the poor man, which consists chiefly of pence, would be proportionately increased, while his wages being payable in gold or silver of the present coinage would undergo no alteration. This kind of coinage would therefore operate to the disadvantage of the artizan. A writer in the *Athenæum* proposes the following scheme of a new coinage, and we think it possesses many recommendations:—

		Shillings.	Decimes.	Centimes.
Gold..........	Sovereign .... value	20	—	—
Ditto	Half-sovereign	10	—	—
Silver	Crown......................	5	—	—
Ditto	Victorine, or two shilling piece	2	—	—
Ditto	Shilling	1 or	10	—
Ditto	Royal	—	5	—
Silver or mixed..	Piece of 2 decimes (not essential)	—	2	—
Copper or mixed.	Decime	—	1	10
Copper........	Piece of five centimes........	—	—	5
Ditto	Piece of two centimes........	—	—	2

Nearly equal to ¼*d*.

Whatever new system were adopted, a certain degree of confusion would necessarily take place, which appears inseparable, indeed, from any state of transition. Among the poor this confusion would probably be the greatest; it being more difficult in their case to overturn old associations, and establish new and scientific relations. We trust, on every account, that their interests may be looked to in any change. If it be not the loss they suffer, and which experience will soon make known, it will not fail to occasion much discontent, and might indeed defeat the scheme; for it could hardly fail to have the effect of causing the present copper coinage to be retained with great pertinacity, and so long as it remained in extensive circulation, the new scheme would be, we think, nearly inoperative.

The advantage to be obtained by the introduction of the decimal scale into our system of weights and measures, is much less, we think, than its introduction into the system of our coinage. Nevertheless, it is not to be doubted, that the decimal division of our weights and measures would also be a great improvement: the only question is, whether the benefit derived would be commensurate with the disturbance occasioned by the change to the habits and associations of the people. The Report of the Commission we have already named recommends, judiciously perhaps, that no alteration should now be made in our existing measures of length, which are the inch—the foot—the yard—the furlong, and the mile. The chain is the only decimally divided measure of length we have; it was introduced many years ago by Gunter, to facilitate the operations of land measuring, and is now in universal use for that purpose.

The multiples and submultiples of the imperial pound are as follows :—

The ton	2240	lbs.
Hundredweight	112	lbs.
Quarter	28	lbs.
Stone	14	lbs.
Ounce	$\frac{1}{16}$	lb.
Grain	$\frac{1}{7000}$	lb.

The stone is a variable measure,—the stone used by the London butchers being only 8lbs.—and the Commission propose that this weight should be replaced by a new stone of 10lbs., and the hundredweight by a quintal or centner of 100lbs. This change would probably involve a destruction of weights to the extent of 30,000 tons; and as the loss would make the measure unpopular, it is proposed by the Commission, with the view of diminishing this objection, that the government should exchange the new weights for the old, without any charge. The expense entailed upon the government by this act of liberality is estimated at about £150,000. The system proposed by the commission is as follows :—

Millene	1,000	lbs.
Centner	100	lbs.
Imperial stone	10	lbs.
Cent	$\frac{1}{100}$	lb.
Millet	$\frac{1}{1000}$	lb.

To these alterations we might reconcile ourselves, but we think any alterations in the weights and measures should not take place at the same time as the alteration of the coinage. The effect would be to breed the greatest confusion, such, indeed, as in our opinion, would probably defeat the scheme. The alteration in the coinage should, we think, be made first, and the value of the new coins having become thoroughly settled in people's minds, the alteration in the measures might then be introduced with some chance of success. The writer in the Athenæum, whom we have already mentioned, recommends certain alterations in our liquid measures, which, however, would not accomplish their reduction to the decimal scale. We do not concur in his recommendation, as we think it would occasion a great disturbance without any equivalent good. We however give his recommendation in his own words :—

"It would be very desirable that every sort of produce, excepting liquids, should be sold by weight, but as some articles will; from long custom, continue to be sold by measure, it appears indispensably necessary that some alterations should be made in the system of measures, both for dry and liquid commodities. The present divisions of the measure for dry goods are, as a binary scale, nearly perfect, each measure (with a single exception) dividing itself into two, four, or eight parts. These measures, besides, are so connected with all mercantile transactions, both large and small, that their alteration would cause great inconvenience, and would perhaps be altogether needless, until some general system, based on scientific principles, shall be adopted. But, if we retain the present division of the scale of measure for dry commodities, we ought to render it as simple as possible, by rejecting several unimportant subdivisions. The most important alteration, however, which could be made in the measure of capacity, would be to assimilate the measures both for dry goods and liquids,—and this might the more easily be effected, inasmuch as the names and capacities for both kinds of produce are the same up to a gallon. The irregularities in the scale of liquid measures are now very great, and, moreover, different kinds of liquids are sold by measures of various capacities, which are called by the same name, as for example, the anker or firkin of ale only contains eight gallons, while the same measure of beer contains nine gallons. The pipes, hogsheads, and butts of different descriptions of wine vary very considerably. It is therefore proposed that the following scale should be used both for dry goods and liquids :

		Dry.		Liquid.
8 Pints	1	Gallon	=	Gallon.
8 Gallons	1	Bushel	=	Anker.
8 Bushels or Ankers	1	Quarter	=	Cask.
8 Quarters or Cask	1	Load	=	Tun.

"It will be seen that the Load corresponds with the measure termed a *Wey*, which weighs five quarters, being the only number belonging to the decimal scale which has been used in dry measures. The proposed *Tun* would contain 2,048 pints. The wine tun is now calculated to contain 2,016.

"It is seldom that any measure of liquid (except for medicines) is required of less capacity than half-a-pint, but perhaps it might not be useless to calculate one as low as the one-eighth of a pint, which might properly be termed a *Minim*."

He also proposes an entire regeneration of our linear measures, and his reasons for this change carry to our mind considerable weight.

"In estimating small distances, and even those which extend to several miles, such as the height of mountains, the depth of the sea, &c., the calculation is almost invariably made in feet; and our minds being accustomed to this mode of reckoning, we find less difficulty in forming a notion of a height of 30,000 feet, than we should if it were stated to be 10,000 yards. In calculating greater distances, which could scarcely be computed in feet—those of astronomy for example,—it would certainly appear a much more simple method to calculate them by tens, hundreds, or thousands of feet, than by the irregular measures of yards and miles; besides, the adoption of the foot as the primary unit of the measure of length would not interfere with any recorded observations; for those which have been made in miles, or other large measures, could easily be reduced into feet. Again, the foot would be an equally eligible measure for all purposes of trade; for if from long association it would be difficult to substitute a new measure for the yard, the foot offers a ready solution for the difficulty; and it would be soon found as easy to make purchases by one measure as by the other."

Our scheme of linear measures, would then stand as follows :—

10 Dimes	1	Foot.
10 Feet	1	Decempede, or 10 foot stave.
10 Decempedes	1	Centipede.
10 Centipedes	1	Millepede.
10 Millepedes	1	Myriapede, nearly two miles.

A mile contains 5,280 feet, a myriapede would contain 10,000.

By this scheme the advantages of the decimal scale would be completely realized, and at a less inconvenience, we think, than by the adoption of any other primary unit than a foot. The only inconvenience, indeed, of any serious amount would be caused by the substitution of tenths of a foot for inches. Many instruments, however, are already divided in decimal parts of a foot, and some also of our measures. The *Edinburgh Review* in discussing the important subject of metrical reform, gives several striking illustrations of the impolicy of rash, and over scientific legislation relative to our weights and measures. We select the following :—

"The fault which was committed by the authors of the metrical system was similar, both in its character and results, to that which was committed by the authors of the Act of Parliament of 1824: the first declared that the *mètre prototype* is a certain definite and assigned portion of the earth's meridian, *which it is not;* and, if lost or injured, that it shall be restored to the same length, in conformity with its definition, *which cannot be done.* The second enacts, that the standard yard is a certain definite portion of the length of the seconds pendulum, *which it is not;* and, if lost or injured, that it shall be restored to the same length, in conformity with the definition, *which cannot be done.* They are lessons which are well calculated to humble the pride of our philosophy, and to teach us to temper the most secure and confident of our convictions, by a becoming sense of the very limited powers both of our observation and reasoning.

"The law of the 18th Germinal 1794, which established the provisional *mètre* and *kilogramme*, before their bases were finally settled, changed all the ancient names as well as values of the measures in use—adopting a uniform and convenient decimal nomenclature, though much better suited to the genius of the French language than our own; but the subsequent law of the 18th Brumaire, 1798, which was founded upon the Report of the Commission, recognized the use of several of the old names—such as *lieu, perche, quintal, livre, gros, muid, setier, boisseau, pinte, arpent*—with new significations; a fatal error, as tending to perpetuate those ancient associations of names and things, whose rapid and certain obliteration was so necessary to the complete reception of the new system. It would appear likewise, that no adequate precautions were taken to distribute copies, or to enforce the use of the new measures; or to withdraw or prohibit the old; or to subject the measures in use to the proper revision and inspection of the officers of the Government. The consequences were such as might have been expected; the old measures and their subdivisions continued in very general use during the whole of the Consular and Imperial government; and they were finally sanctioned and prescribed as the *systeme usuel*, upon the restoration of the Bourbons, as one of the many impolitic and indirect expedients resorted to by that unhappy family, with a view of restoring the recollections of the monarchy. In the year 1837, however, a new law was passed, prescribing the use of the decimal system and nomenclature in all its integrity, which was ordered to be universally enforced from the beginning of the year 1840. The decimal system, which was introduced into Belgium by the Imperial government, is also in full operation. All vestiges of other systems have disappeared.

"The impolicy of attempting to alter primary units, where there exists no power in the Government, or impulse in public opinion, to enforce the alteration, was never more strikingly exemplified than in the fate which has attended the French division of the quadrant. If the ancient *nonagesimal* degree of the quadrant had been retained, and if the alterations had been confined to decimalizing its subdivisions, there is little doubt but the authority of the great philosophers who proposed them, and the increased beauty and symmetry which they would have given to all astronomical processes and records, would very speedily have led to their universal adoption; but the change from the *nonagesimal* to the *centesimal* degree had no connexion whatever with the extended use of the decimal system, or with improved processes of calculation; whilst it tended to disturb unnecessarily ancient associations, to antiquate all our astronomical records, and to render useless a great part of our astronomical and logarithmic tables. The consequences have been such as might have been foreseen; the *centesimal* degree has been abandoned, and the *sexagesimal* scale of submultiples of the *nonagesimal* degree—the most inconvenient of all the vestiges of ancient astronomy—has continued to be retained. It only remains for us to express our earnest hope that the time is not far distant, when a convention of European Astronomers will give such a sanction for proposing, and such a pledge for adopting, the *centesimal* division of the *nonagesimal* degree, that we may feel secure of the general acquiescence of men of science in an alteration the importance and necessity of which is now so generally felt."

Whatever be the changes, however, and whenever introduced, we think it obvious that the change in our coinage should be first accomplished, and the confusion consequent thereupon have completely subsided, before any change in our weights and measures be even thought of. The time of the transition too, should be abridged as much as possible, to which intent the Government might employ some of the servants in every town, such as the post-office authorities, or the officers of customs or excise, to receive the old coinage and issue the new. A limited period too, should be given, within which only the old coinage would be a legal tender. The introduction of a decimal monetary system, would thus be effected without any material disarrangement; and the value of the different pieces of money issued, may be made such as to entail no loss upon any party. Under these circumstances, the introduction of the plan, if well managed, could hardly fail to be productive of the most beneficial effects; and, we trust we may see it carried out without much further delay.

Art. X.—PUGIN'S CHRISTIAN ARCHITECTURE.

An Apology for the Revival of Christian Architecture in England. By A. Welby Pugin. London: Weale, 1843. 4to. pp. 51.

The title of this work naturally leads one to imagine, that it must be an uncommonly meek and conciliatory production. This impression, however, the first ten lines of the work will effectually dispel, and a further progress will display an amount of bigotry, acerbity, and intolerance, such as we have never found heaped together in any other production. The object of the book is to advocate the merits of Gothic architecture, and so well does it do this, that if we could suppose such books could be read, a few of them would, we are convinced, put out the Gothic style altogether. People would hate the thing advocated, because they could not fail to hate the way in which the advocacy was done, and would turn from both with disgust, as the bad symbols of a bad spirit. Mr. Pugin, it appears, is a Catholic, and for this we cannot of course have the least objection against him; but, we think, the mode in which he introduces theological differences into a question with which shades of speculative belief have nothing whatever to do, is in every respect injudicious; and must be as offensive to the more intelligent of those whose prejudices he hopes to conciliate, as to those against whose prejudices his dogmas naturally run counter. Of this, at least, we are very sure, that the *spuma* of imbecile intolerance Mr. Pugin has here put forth must be extremely prejudicial to the doctrines he advocates; and unprejudiced persons will conclude, that if the spirit which here shines forth is the natural product of such doctrines, they are equally unfit for a Christian and a gentleman.

The creed of Mr. Pugin, is a simple one, and may be very briefly stated. It is, that Gothic architecture is the perfection, not merely of human, but *superhuman* wisdom; and that all who do not acknowledge its title to this high position, have neither taste nor Christianity. This reasonable and amiable doctrine, expanded into every form of dulness, and embellished by every epithet of discourtesy, forms the sum and substance of Mr. Pugin's book. It is not that he claims for himself a right of judging, he offers to others, but he says that his opinions are right, and those of everybody else are wrong; and he hurls his anathemas with no sparing hand against those who are stiff-necked enough to doubt his title to infallibility. In the present state of the world, people, we suspect, will not tolerate a pope in architecture, and will laugh at, if they do not pity, the extraordinary folly which makes any man aspire to such a position.

We have never troubled ourselves much with Mr. Pugin's previous productions, but without going further, we think, we have enough before us to show that he does not understand the principles of his art. Of this, indeed, the very statement of the object of his tract furnishes one proof: the object he says, is to show that Gothic architecture is the *only* correct expression of the faith, wants, and climate of our country. Now, no one expression of such an object, can be the only true one so long as almost every mind differs in some respect from every other, and will receive a correspondently different sensation from the same object; the statement, indeed, is just about as absurd as if Mr. Pugin were to say, that no man could see without spectacles, because they might be necessary to his vision. This fault, indeed, of erecting his personal associations into universal and immutable truths, is Mr. Pugin's besetting sin. He thinks it the height of barbarism, or perversity, in other men not to see exactly as he does; and seeks to convert a matter of taste into a matter of conscience. Grecian architecture seems to call up in his mind images of heathen gods and goddesses, and he therefore, concludes, that they must call up those images in every mind. He appears to forget, that there are a vast number of persons who know nothing of Greek mythology, and to whom such objects can really signify nothing, whilst in other minds their continual and familiar contemplation has deprived them of all exotic association, and awakens no other emotions, than if the Greek orders had been invented by Sir Christopher Wren, or Michael Angelo. But we must give our readers one or two specimens of Mr. Pugin's logic on this subject, and we select the following as one of the best.

> "If we worshipped Jupiter, or were votaries of Juggernaut, we should raise a temple, or erect a pagoda. If we believed in Mahomet, we should mount the crescent, and raise a mosque. If we burnt our dead, and offered animals to gods, we should use cinerary urns, and carve sacrificial friezes of bulls and goats. If we denied Christ, we should reject his Cross. For all these would be natural consequences: but, in the name of common sense, whilst we profess the creed of Christians, whilst we glory in being Englishmen, let us have an architecture, the arrangement and details of which will alike remind us of our faith and our country, —an architecture whose beauties we may claim as our own, whose symbols have originated in our religion and our customs."

In much of this we concur; we think, with Mr. Pugin, that our architecture should spring out of *our* religion and customs, or in other words out of such modes and feelings *of the time* as have a foundation in nature; and it is, therefore, we are against the revival of any old architecture, which speaks of the customs and superstitions of a former day, and is representative neither of present opinion, nor present science. It would appear, however, to be Mr. Pugin's doctrine, that there is something mystical and sacred in Gothic architecture. Thus, he says:—

> "It has been frequently objected by the advocates of paganism, that the pointed style, especially Christian, was not developed till several centuries after the crucifixion of our Lord; but this is measuring the ways of God by mere human capacity. How long were the chosen people of God allowed to exist before the erection of the great temple of Jerusalem was permitted? Did not the skins of the desert typify the polished stones of that wondrous structure? And may we not say that the foundations of Cologne were commenced in the catacombs of the eternal city? Like Protestants who rail at ecclesiastical solemnity, because it is not to be found in the persecuted church of the apostles, they urge the non-existence of spires under Roman emperors as a proof, that they were not generated by the Christian principle."

And, again,

> "The change which took place in the sixteenth century was not a matter of mere taste, but a change of soul;"

in other words, that the adoption of pagan decorations indicated a pagan spirit. Now, we think, nothing could furnish a completer refutation of Mr. Pugin's hypothesis, than the very instances he has adduced in its support. We have no right to suppose, that Raffaelle and his contemporaries in the building, or decoration of St. Peter's were not as good catholics as Mr. Pugin himself; and, indeed, it is well known Raffaelle expected to have been made a cardinal. Solomon, it is well known, was indebted to the pagan Hiram, king of Tyre, for enabling him to build the temple. Yet, he was a sincere worshipper of Jehovah; and when the great lights of religion can see no impropriety in borrowing pagan resources, or contrivances in art, we think, the glow worms may afford to show an equal docility.

Mr. Pugin, however, maintains that his hostility to such principles is the result of deep inquiry. In page 5, he says,

> "I have not unfrequently been denominated by the perpetrators of these absurdities as a fanatic for pointed design, a blind bigot insensible to, and ignorant of, any beauty but that of the middle ages. So far from this, I much question if I am not better acquainted with the principles on which the various styles of pagan antiquity were founded, than many of their warmest advocates."

In page 20,

> "How is it possible for any good results to be achieved with the present principles of architectural education? Can we ever hope to see a Christian architect come forth from the Royal Academy itself, where deadly errors are instilled into the mind of the student, with the very rudiments of instruction? Pagan lectures, pagan designs, pagan casts and models, pagan medals, and, as a reward for proficiency in these matters, a pagan journey!"

But he consoles us with the assurance that he can apply a remedy.

> "God grant me the means, and I would soon place architectural studies on such a footing that the glory of these latter days should be even greater than that of the former."

This at least shows, that Mr. Pugin has no mean notion of himself, and as clearly, that Mr. Pugin is undeserving of the means he covets. Why, we should like to know, is a person to be debarred from pursuing pagan studies, if he so thinks fit? Would Mr. Pugin like to be debarred from pursuing feudal ones? But this is merely another phase of that hateful intolerance which shines through every sentence of this intolerant book. We see very clearly to what condition we should soon be reduced, if we were at Mr. Pugin's tender mercies. All converse with the great minds of the classic ages, would be effectually cut off, because they were not Christian; and we should be condemned to herd once more with half-cracked saints, and ascetic inquisitors. That universal benevolence, which is the reflection of a heavenly grace, and which gilds all nature with the rays of its own divinity, would wax faint, and finally expire; and the waters of the heart which nourish our purest affections, would be turned into bitterness. Nothing would be esteemed worthy of being loved, except what was Christian, or in other words, except what was Roman Catholic; and the goodness of God would be narrowed to the bigotry of a sect.

We will not waste words, however, upon Mr. Pugin's intolerance, which will carry its own antidote, we believe, to the minds of almost every reader whether Protestant or Catholic,—for we are very confident that the spirit this book breathes does not extend to the great bulk of catholics, at least in our own country. We shall now proceed to give a few specimens of the very decorous way in which Mr. Pugin speaks of the practice of his brother architects, or at least of such of them, as fortunately happen to have a different taste from his own. We take a few examples of this delectable elocution almost at random.

> "It is a *perfect disgrace* to the Royal Academy, that its Professor of Architecture should be permitted to *poison* the minds of the students of that establishment

by propagating his erroneous opinions of Christian architecture. The influence which his position naturally gives him over their minds is doubtless considerable, and the effect of his instructions proportionably pernicious. Not content, however, with the disparagement of ancient excellence, which he introduces in his official lectures, he is *practically* carrying out his contempt of pointed design in both Universities, and in a manner that must cause anguish of soul to any man of Catholic mind and feeling."

Again,

> "A man who paganizes *in the Universities* deserves no quarter; and it becomes a question whether the greater share of blame attaching to such transactions is due to the architect who could so wed himself to the *bastard* compositions generated in his studio, as to intrude his *huge deformity* not only in the vicinity but on the site of ancient excellence; or to the authorities of the University, who, in the very teeth of the present revival, have sanctioned so *gross a violation of propriety*. But their *madness* is paralleled at Oxford, where the same architect is erecting another *unsightly pile of pagan details*, stuck together to make up a show for the university galleries immediately facing the venerable front of St. John's."

The following relates to the gateway at the entrance of the Birmingham railway, which is universally admitted (except by monomaniacs) to be an admirable construction. It is not, perhaps, a fit gateway for the place, but that, if a fault, is the fault of those who wished such a gateway to be placed there; the merit of the architect would be neither increased nor diminished had it been placed in Hyde-park, or any other situation.

> "Hence the colossal Grecian portico or gateway, 100 feet high, for the cabs to drive through, and set down a few feet further, at the 14-inch brick wall and sash-window booking-office. This piece of Brobdignaggian absurdity must have cost the company a sum which would have built a first-rate station, replete with convenience, and which would have been really grand from its simplicity."

And, further on,

> "Of a truth, if architectural offices were stopped up, and fused as they serve wasps' nests in the country, we should be freed from a mass of poisonous matter that is still depositing in these places."

We shall not vex our readers with more of this trash, and shall conclude our extracts with the only passage we have met with in the book, in the doctrines of which we can say we concur.

> "There is no fear at the present time of sacred representations being regarded with superstitious reverence: there is far greater danger that, holy symbols and figures being replaced by pagan fables or bare walls, men will lose all remembrance of the glorious mysteries they represented. It must be admitted that, in opposition to true Catholic doctrine, some images were regarded by the ignorant with a superstitious veneration, and certain representations were tolerated in the churches, which were highly objectionable. There can be but little doubt that all these matters would have been reformed, without violence or occasion of scandal to weaker brethren, by the decrees of the Council of Trent; and nothing can be more absurd and unjust than persons continually raking up, at the present time, old extravagant indulgences and local practices, which have been condemned centuries ago by ecclesiastical decrees, and some hundreds of which are denounced separately in works printed by authority.
>
> "The use and intention of sacred images is to raise the heart of the spectator from the figure to the reality, and to instruct the faithful in the mysteries of religion by lively representation. The soundness of this principle is fully acknowledged by the general practice of the present time,—in the multitude of biblical illustrations prepared for the instruction of youth.
>
> "The church only requires that honour and veneration for sacred symbols which their character naturally demands, and which is essentially the same as that yet given in the Anglican Church to the holy Name of Jesus; and is paralleled in temporal matters by the external respect shown to the throne in the House of Peers, or the quarter-deck of a man-of-war. Sacred imagery is a noble field for the exercise of the highest powers of art; and painting and sculpture, when devoted to the service of the church, are calculated to improve and elevate the religious feelings of a nation in a surprising degree."

Our readers, we suspect, have by this time had enough of this precious production, and the numerous extracts we have given will enable them to form a safer opinion, than if they relied on any judgment of ours. To those who conceive that such doctrines or such a spirit are the characteristics of Catholics generally, an impression, we fear, will be conveyed unfavourable to the Catholic faith, and, we do think, the Catholics ought to disclaim all participation in the hot and hateful sentiments to which Mr. Pugin has given utterance. Not that Gothic architecture may not be the best after all, but that such weapons as Mr. Pugin uses, and such a spirit as he breathes, must bring disgrace and suspicion on any cause which does not disclaim all connexion with them. The predominant feeling in our mind, in the perusal of the work, would have been indignation, had that feeling not been expelled by contempt.

The work is embellished by several bad plates, in which the absurdity of Grecian and Egyptian architecture is conclusively shown, by grossly caricaturing them. By the way of making these plates still more captivating, their titles are written in a species of letter which may be imagined to be a cross between English and Chinese. Several angels are depicted, which have the appearance of having made too free with the bottle, and a few monumental brasses, which are more like dolls dipped in melted wax, than anything else we now remember. The literary merits of the work are in our eyes only of a very middling order; and although we might be entitled to find some fault on that score, we do not regret the mediocrity we indicate. We are sensible that an eloquent and conciliatory advocacy will win converts, to even the most hateful doctrines; and if such doctrines are to be shed abroad, we are best pleased that it should be by a pigmy.

Art. XI.—RAILWAY ACCIDENTS.

Report of the Officers of the Railway Department of the Board of Trade to the President of the Board. London. 1843. (Second notice.)

In our last Number we stated generally the character and contents of this work. We shall now proceed to lay before our readers a few extracts, and we shall begin with the following, from page viii. of the Report:—

> "Under the second head, of accidents arising from causes which are to a certain extent unavoidable, the experience of the past year points to two principal sources of danger; 1st, the sudden breaking of axles; and 2nd, unexpected slips of earth and failures in the works of railways. The report on the accident of the 7th December on the London and Birmingham Railway, shows that axles made of the best materials will occasionally break without giving any warning of the approaching fracture, that can be detected by any process of examination short of taking the wheels and axle off the engine, and putting them upon the lathe. It is certain, however, that in a very great majority of cases the breaking of an axle, whether it be the fore or cranked axle of a six-wheeled or four-wheeled engine, or the axle of a carriage, is not attended with any dangerous consequences to the train.
>
> "With the exception of the accident of the 7th December on the London and Birmingham Railway, no instance has ever been returned to this Department of an accident attended with injury to the public owing to the breaking of the axle of an engine; and only four cases, namely, on the North Midland Railway, 13th September, 1840; the Hull and Selby, 23rd December, 1840; Garnkirk and Glasgow, 5th January, 1841; and Sheffield and Rotherham, 3rd June, 1841,—in which part of a train was thrown off the rails, and injury sustained by the passengers, ascribed to the breaking of the axle of a tender or carriage.
>
> "The disastrous accident on the Paris and Versailles Railway was occasioned by the breaking of the axle of an engine; but this can scarcely be considered as a precedent applicable to English railways, since the description of engine, viz., a four-wheeled engine with *outside* bearings has been long since abandoned in this country, and is now quite unknown on passenger railways. The extensive loss of life on that occasion is also attributable to the use of a much slighter description of carriage than is ever employed upon English railways, as well as to an imprudent rate of speed upon rails in bad order. With carriages strongly and solidly built, and provided with powerful buffer-springs, it is scarcely possible that any accident which could happen upon a railway should be attended with a loss of life at all approaching that which took place on the melancholy occasion referred to."

These observations, especially that part of them which relates to the accident on the Paris and Versailles Railway, will, we are confident, be read with great interest. The following, on the practice of propelling from behind, shows clearly the evils of that method of propulsion.

> "In the event of any sudden stoppage in front of the train, either from the engine running off the rails, breaking down, or coming suddenly into collision with a slip of earth or other obstacle, it is evident that the danger would be greatly increased if a second engine were propelling from behind. We have therefore omitted no opportunity of discountenancing this dangerous practice; and, except in ascending very steep inclines, where the speed is necessarily slow, and therefore the objections to the employment of an assistant engine in the rear of the train do not apply to the same extent, we are not aware of this course having been recently adopted in any instance, except occasionally upon the Brighton line, where we have reason to hope that it will be discontinued, in compliance with the recommendation of this Department."

We have only room for one more extract, and that shall be of a Report of Colonel Pasley's to the Earl of Ripon on Railway Accidents generally. We take the following:—

> "After the unfortunate accident which took place on the 8th instant, on the London and Birmingham Railway, I went to the Vauxhall terminus of the South-Western Railway, to inquire into an accident, unattended with personal injury, which took place on that railway on the 10th inst., from the breaking of a crank-axle of one of their six-wheeled locomotive engines. On inspecting the fractured iron, it seemed to be of good quality, but had been made in an improper manner by welding flat parallel plates together, contrary to the usual and more perfect custom. At that station I had an opportunity of comparing six-wheeled and four-wheeled locomotive engines, and I have made the same comparison since on the Croydon Railway; and I now beg leave to submit to your lordship the result of my observations and reflections upon railway accidents, whether depending on the construction of the locomotive engines or other causes.
>
> "1. *The usual construction of locomotive engines compared.*—Four-wheeled engines, with inside bearings, are exclusively used on the London and Birmingham Railway, in compliance with the opinion of Mr. Bury, the superintendent of the locomotive department of the Company; and, as the axles of those engines had often been broken, without any disastrous result, and that railway, (which is extremely well

managed,) had been as free from accidents, if not more so, than any other, I did not feel myself warranted in making any official remarks in depreciation of four-wheeled engines, until the recent accident of the 8th inst. In that accident, the fore axle of one of their four-wheeled engines broke off transversely close to the inside of the nave of the wheel, so that the wheel was thus, as it were, entirely cut off, and got away from the engine, which, therefore, by having three wheels only, lost its former direct motion, and moved round with a circular motion, which threw it off the rails and carried it down an embankment, where it rolled over, and was found with its head reversed, that is, pointing in a contrary way to its original course, so that it must have described a semicircle before it stopped. Further particulars relating to this accident were reported in my letter to your lordship of the 13th inst.

"In conversing upon the subject with Mr. Bury, and with Mr. Creed, the secretary of the London and Birmingham Railway Company, these gentlemen both declared their opinion, that the same would have happened to a six-wheeled engine, under the like circumstances; but there were none but four-wheeled engines on that railway, so that I could not make a personal comparison of the two sorts at the period of the conversation alluded to. Having since done so with great attention, as before mentioned, and having allowed myself ample time to consider the question, I think it my duty, with due respect for those two gentlemen, to record my dissent from their opinion.

"In the case of any of the axles of a four-wheeled engine, of the London and Birmingham Railway pattern, snapping off short, close to the inside nave, the wheel must necessarily get away altogether, there being no outside framing to confine it.

"In the case of the fore axle of a six-wheeled engine with outside bearings breaking, on the contrary, as the journals are outside, the fracture must necessarily be between the bearings; in which case the experience not only of six-wheeled but even of four-wheeled engines proves that no serious danger is likely to result. It has been urged, and I believe justly, that when an axle breaks between the bearings, the wheels are more deranged and more liable to leave the rails by the outside than by the inside mode of fixing; but the fore wheels of a six-wheeled engine with outside bearings cannot get away altogether under any circumstances, unless an axle were to snap short off in two places at once, close to and on each side of the nave of one of these wheels, which is impossible. Setting aside, therefore, the supposition of a double fracture, if the fore axle of a six-wheeled engine breaks, no matter where, the wheel is confined closely between the strong frame of its outside bearings and the smoke-box, which is also sufficiently substantial, so that it cannot possibly disengage itself entirely. Hence the train may be retarded and stopped, but the engine can neither break down nor be thrown violently off the rails; in short, no accident injurious to the safety of passengers is likely to occur. If the crank or centre axle of a six-wheeled engine should be fractured, the fore and hind wheels alone are capable of supporting the whole weight of the engine, so that it cannot break down. If the hind axle of a six-wheeled engine should break, and even supposing an impossibility, namely, that both the hind wheels should come off, no result injurious to the public safety can be apprehended, because the centre of gravity of locomotive engines of this description is a little in front of the centre axle, and therefore the engine will still remain in the satisfactory state of stable equilibrium.

"Having thus stated my opinion, and the grounds on which I have formed it, as to the superior safety of six-wheeled engines, I beg leave to report on the nature of accidents likely to be attended with danger to railway passengers.

"2. *Collisions of Trains or Locomotive Engines.*—Collisions of trains meeting each other, which are the most dangerous, cannot take place on railways having double lines of rails, if the switches are self-acting, and such that no train going at full speed can quit its own line, on coming to the points where the crossings are laid out, by any carelessness of the engine driver.

"Collisions from one train running into another from behind cannot possibly be prevented by any mechanical means. If the regulations of the railway company are good, and their enginemen are skilful and possessed of judgment and presence of mind, such collisions cannot happen except in the case of intoxication. Sobriety is therefore indispensable in this class of men, for without it all other qualifications go for nothing.

"3. *The breaking down of Locomotive Engines or Railway Carriages.*—If a locomotive engine or its tender break down at the head of a train, the carriage immediately in rear of the tender suffers the most, and the second and third carriage also may be more or less damaged. Generally, in cases of this kind, the carriage next to the tender is dashed to pieces, or nearly so; and the passengers, when any have been in it, have been killed or severely injured, whilst those in the next carriages have either escaped, or been less injured. Hence the expedient of placing an empty carriage of some sort next to the tender has been generally, and I think justly, deemed conducive to safety. A truck loaded with hard materials, such as iron, stone, &c., placed next to the tender, might on the contrary do infinitely more harm than good. It has been suggested that a peculiar carriage, with more powerful buffer-springs, or, as it were, all buffer-springs, would be desirable, instead of a common carriage, and I believe so; but it is still more important to adopt such measures as shall do away with the risk of locomotive engines breaking down, or being suddenly stopped, by some obstacle capable of producing that effect.

"4. *Slips in Cuttings and Embankments.*—These have invariably arisen from the slopes having originally been made too steep, perhaps from want of experience on the part of railway engineers, who had, as it were, to create a new art, for they have never in the first instance allowed a slope of more than two to one, even in the worst descriptions of soil, which I should myself, when new to the subject, have considered ample; but, from subsequent experience and observation, I am of opinion that, in all deep cuttings in plastic clay, slopes of four to one on one side, and of three to one on the other, ought to have been allowed; for, though both sides are liable to slip in such soil, yet one side is usually more exposed to this injurious action than the other, owing to the inclination of the strata. But it may be doubted whether, in all cases, inexperience on the part of railway engineers could have been the cause of their adopting insufficient slopes, because, in Sir Henry Parnell's book on road-making, published so far back as 1833, it is laid down as one of the rules, &c., professedly derived from the practice and experience of the late eminent civil engineer, Mr. Telford, that in the London and plastic clay formations, it will not be safe to make the slopes of embankments or cuttings that exceed 4 feet in height with a steeper slope than three to one. As most of the great railways have been executed since that period, in some of which the depths of cuttings are from 15 or 20, and even 70 feet, and the heights of embankments also very considerable, a query occurs, whether inexperience could have been altogether the cause of neglecting so salutary a maxim. May not, in some cases, the apprehension of deterring the public from subscribing to a new railway, have caused a steep slope to have been adopted in preference to a flatter one, because the latter would have made the estimated expense of the removal of earth much greater? However that may be, experience has shown that, after embankments have once come to their bearings, slips are not to be so much apprehended as in deep cuttings. In the latter, laid out as before observed, with slopes not exceeding two to one, experience has proved that slips must be expected for years after the opening of the railway. The repeated slips on both sides of the Croydon Railway, for example, took place nearly two years, and that on the west side of the Bughrook cutting on the London and Birmingham Railway more than four years after these lines had been opened; and in both cases, notwithstanding that both lines of rails were completely buried by the immense masses of earth thrown down, yet no danger to passengers resulted, owing to these cuttings having fortunately been carefully watched. This precaution, therefore, of continual and careful watching, is absolutely necessary, in respect to embankments and cuttings in plastic clay, especially the latter; for, if not discovered in time, a very insignificant slip of earth from one of the sides of a cutting, though capable of being removed in a few hours, might, by suddenly stopping an engine at full speed, endanger the lives of the passengers in the carriages nearest to the tender, an instance of which actually occurred on a different railway about a year ago. But if the state of cuttings and embankments be always carefully attended to, no serious accident is to be apprehended from any slip, however considerable. I shall only further observe, that it is well known that not merely the nature of the slopes, but also the proper drainage of cuttings and embankments, are essential considerations, both in preventing slips in the first instance, as well as the repetition of them, in unfavourable soil."

ART. XII.—JOINT STOCK COMPANIES.

AN insatiable appetite for joint stock projects is one of the vices of the present generation. Among the ancients such things were almost unknown, and our forefathers were content to resort to them only on extraordinary occasions; but now the most trivial invention that may be brought out must have its company. Every branch of industry is overrun with them, from the company for ruling India to the company for sweeping chimneys. We do not mean to say that these companies are not, very often, excellent things; but we think they are as often, perhaps, very much the reverse; unless, indeed, it be argued that a sink of some kind is necessary for the accommodation of those who have too much money. The fact appears to be, that the joint stock principle is beneficially applicable to such undertakings only as are beyond the strength of any few private individuals to execute; such, for example, as long lines of railways, canals, water and gas works on the great scale, and other things of that nature, which require a greater influence and capital than a few private individuals can command. In all other cases, the superior vigilance, promptitude, and zeal which wait upon private enterprise, conspire to render it the more beneficial. And in any contest between *the same amount of wealth*, in the shape of a private enterprise and that of a joint stock one, the joint stock undertaking will almost always be worsted. The cause of this disparity is sufficiently obvious: In joint stock undertakings each of the shareholders has, comparatively, but a small interest; and whether the undertaking is managed a little better or a little worse, will scarcely matter to him. Against very bad management he will, of course, cry out; but if the management be only tolerable, he will not trouble his head about the matter. The managers, again, for the same reason, are apt to become supine, and will be less likely to retrench all unnecessary expenditure, than if it all came out of their own pockets. It must not be supposed, however, that our position is, that no joint stock company can be managed with economy and vigour—for there are some we could mention which are managed with both; but we think it the tendency of the joint stock principle to weaken that anxiety for profit and retrenchment which will be sure to obtain when a man knows that the gain is all his own, or has to be shared with only one or two associates, and that, therefore, the joint stock principle should never be resorted to in those enterprises to which the better principle of private enterprise can be extended. In those cases, too, in which the joint stock principle appears necessary, the French plan of making the managers responsible for the whole liabilities of the company, should, we think, as far as possible, be pursued. The managers would thus be less likely to lead the company into hazardous courses: and should they feel themselves incompetent, would be more disposed to resign the reins into more skilful hands. With these remarks, we shall introduce to the notice of our readers a few of the more recent and remarkable joint stock enterprises, leaving them to apply what we have said, as far as it may appear applicable.

The first Company we shall mention is, the Chimney Sweeping Company, or as it styles itself, we suppose, for the sake of greater dignity, "The Ramoneur Association." This company sprung out of the Act of Parliament for the suppression of chimney-sweepers; and its object is to accomplish the sweeping of chimneys by machinery. The machinery it employs, consists of four brushes arranged in the form of a square with the bristles outside, and each brush is kept out beyond the square by springs, so as to leave a vacancy at each corner of the square. This square brush frame is drawn up and down the chimney by a rope the size of the frame used, when in its expanded state being somewhat greater than the size of the chimney, so that the bristles bear against the sides of the chimney with a certain force. The opponents of this plan say, that this square brush sometimes jams in the chimney, and will not come out, but this the Ramoneur people deny, and which statement is nearest the truth we really cannot determine. We are told, that it is the intention of the Association, to make a regular entry of each application for sweeping chimneys in a house, the execution of the order, and the name of the workmen employed; so that satisfactory proof may be produced in the event of fire taking place of the chimneys having been swept, to obviate legal controversy in reference to fire-insurance, and also to detect, in the event of depredation, the party committing the offence. A guarantee is given against fires by the attendance of an engine consequent on any chimney under contract taking fire. The superintendant, accompanied by a workman, will attend in cases where it is required; and the scale of charges will be regulated after the old system, which varied upon an average from between 6*d.* to 2*s.* 6*d.* for each separate chimney. To those, however, desirous of availing themselves of a more economical system, contracts may be entered into by the year, when the association will guarantee the householder against all fines or fees paid to firemen should the fire originate in any chimney which they contract to keep clean. Periodical visits will be fixed upon for sweeping the chimneys under such contract, which will be duly entered on the books of the association, so that no trouble is caused to the contracting party, they taking the responsibility entirely on themselves by seeing that the work is properly done at stated periods. This is all very well, if it can be carried out with a profit, in the face of the competition of private adventurers.

The next company we shall mention is, the Clock and Watch-making Company. A large portion of the English watch-making trade has emigrated, as is well known to Switzerland, and this company proposes to bring it back, by cheapening the production of watches by means of machinery. The machinery by which this is to be accomplished, is the invention of Mr. Ingold, who is said to have devoted about twenty years to watch-making improvement. There are different machines, for the execution of the different parts; by one machine, it is said 300 barrels can be made in a day, and by five machines, the wheels and balances of 300 movements in the same period. There is another machine, of which the following account has been given us. It will turn both the large and the small plate of a watch at the same time, and each of them on both sides at the same time; plant the centre wheel; turn the sink for the cannon pinion and hour-wheel; turn the sink and plant the depth for the minute-wheel; turn out the plate for the barrel and plant the depth; turn out the plate for the third wheel and plant the depth; turn out the plate for the fourth wheel and plant the depth; turn out the plate for the escapement-wheel and plant the escapement and balance; cut out the plate for the pallets and lever; drill all the holes and tap those necessary; turn the small plate with blocks (in lieu of pillars) attached, all out of one solid piece of brass; then, when the small and large plates have been screwed together, plant and upright the escapement cocks; upright the centre-wheel; upright the barrel; upright the third wheel; upright the fourth wheel; upright the escapement pallets and balance-staff; and turn all the holes out ready to receive the various jewellings and set the jewels of both plates; and all this before the pieces of brass, employed in either case, leave the machine.

It says a good deal for the value of these machines, that some of our eminent makers of chronometers are members of the company. We can see no reason whatever why machinery may not be applied to the manufacture of watches as well as of other things, and we do not conceive these machines, if perfectly successful, will injure the present race of operative watchmakers nearly so much as they imagine. But assuming that the machines are successful, the question still remains whether a company is necessary to work them.

The company has taken large premises in Dean-street, Soho-square, formerly, we understand, occupied by Messrs. Rundell and Bridge. The last time we visited the premises they were not in a state sufficiently adapted to their new purpose to enable us to acquire any adequate conception of the several manipulations.

The last company we shall mention is one still only in embryo, and it scarcely deserves to be classed with enterprizes purely commercial, many of the shareholders being, we are assured, influenced by patriotic motives, and having no wish, or perhaps hope, to get any dividend on their shares. The undertaking to which we allude is a new music hall, which it is proposed shall be erected at a cost of £50,000, to be raised by 10,000 shares, at £5 each. The hall, it is proposed, shall be 150 feet square, and 120 feet high; and it is anticipated that it will be able to hold about 6,000 people, exclusive of the orchestra, which is to be fitted for 1,000 performers. The roof is proposed to be on the suspension principle, so that there will be no pillars in the hall. The orchestra, it is proposed, shall be ninety feet high in its summit, and 150 feet in width, and the organ is to be seventy feet high. This undertaking numbers, we believe, among its patrons Prince Albert and the Duke of Cambridge, and the vice president is the Marquis of Lansdowne, a nobleman always among the first promoters of every laudable enterprize.

The dimensions of this hall may, perhaps, best be judged of by comparing them with those of some other halls of which a conception has been formed. The Birmingham Hall is 140 feet long, sixty-five feet high, and sixty-five feet wide, and contains an area of 9,100 feet. Exeter Hall is not so long, but wider, and contains an area of 9,956 feet. Westminster Hall, the noblest apartment in England, or the world, is 238 feet long, and sixty-eight feet wide, thus containing an area of 16,184 feet; but the proposed music hall, being a square of 150 feet, will contain an area of 22,500, so that it will be half as large again as Westminster Hall, and nearly twice and a half larger than either Birmingham or Exeter Hall. For some of these particulars we are indebted to a little work called *The Journal of Projects.* We had almost forgot to say, that Mr. Beazeley is the architect by whom the designs for the new hall are being prepared.

We hardly think that this undertaking will be profitable in a commercial sense; at least, we should not be disposed to be sanguine on that score. Nevertheless, the great hall lately erected in Glasgow has been more profitable in a commercial sense than almost any one anticipated. The indirect benefits of such a place are, however, very great. In Glasgow, men who formerly spent their time in the lowest dissipation, have been attracted to the Hall by the excellence of its musical entertainments conjoined with the moderate rate for which admission was granted; and the change which was perhaps begun in curiosity, ended, in many instances, in permanent reformation.

ART. XIII.—ANATOMY OF THE STEAM ENGINE. No. 4.

PLATE XI. contains several more of the details of the engines of the "Don Juan."

Fig. 1 represents the bracket for carrying the valve and parallel motion shafts.

Fig. 2, section of ditto.

Fig. 3, horizontal section of ditto.

Fig. 4, the diagonal stay and upper and condenser columns all cast in a piece.

Fig. 5, cross section of framing under paddle-shaft parallel block.

Fig. 6, cross section of upper columns, and ground plan of bolt-holes for securing the upper columns to the under ones.

Figs. 7 and 8, cross sections of diagonal stay at different places.

Fig. 9, cross section and ground plan of flange of condenser columns.

Fig. 10, support for parallel motion shaft, and which goes on top of fig. 1.

Fig. 11, ground plan of framing.

Fig. 12, end view of upper columns and diagonal stay.

Fig. 13, cross section of entablature of under columns.

Fig. 15, section of under columns.

Fig. 16, plan of capital of under columns.

Fig. 17, perpendicular section of cylinder through ports.

Fig. 18, side view of valve casing.

Fig. 19, cross section of valve casing.

Fig. 20, plan of cylinder.

Fig. 21, view of cylinder faces, the valve casing being removed.

Fig. 23, same view, with the valve casing on.

Fig. 22, bottom of cylinder.

Fig. 24, portion of plan of cylinder, with valve casing on.

ART. XIV.—PHYSIOLOGY OF THE STEAM ENGINE. No. 4.

AIR-PUMP.

WE give, in fig. 1, the first attempt we have seen at the employment of the indicator in the determination of the power required to work the air-pump of a steam engine. The common indicator was fixed in the air-pump cover of a steamer fitted up lately in the Clyde, and the pencil described the curve delineated in fig. 1. When the air-pump bucket was at the bottom of its stroke, the indicator pencil was at *a*, showing a vacuum of fully 12lbs. As the bucket rose, the pressure of the compressed air, and vapour above it, also rose till the pencil reached the point *b*, showing a pressure of 6lbs. above the atmosphere. About this part of the stroke the delivery-valve seems to have opened, and allowed a sudden discharge of air, upon which the pressure immediately fell again to about 1 lb. above the atmosphere, as shown by the downward course of the pencil to the point *c*. Here the delivery-valve must have been again acted on by the water lying on the air-pump bucket; and the force required to impel the water through the valve and discharge-pipe raised the pencil to its highest point at *d*, indicating a maximum pressure of 8lbs. above the atmosphere. When the air-pump bucket commences its downward motion, the pressure above it diminishes very rapidly, as shown by the line *e f*.

Diameter of cylinder, 63 inches.
Cover on steam side, 3¾ inches.
Size of steam-ports, 25¾ × 6⅜.
Diameter of air-pump, 3ft. 1½in.
Length of stroke, 6 feet.
Cover on exhausting side, 1¼ inches.
Weight on the safety-valve = 6lbs. per square inch.
Length of stroke of ditto, 3ft. 3½in.
Stroke of valve, 15⅜ inches.
Steam cut off at fully ¾ths of the stroke.
Diameter of waste-water pipe, 12½ inches.

Fig. 1.

Indicator Diagram taken with the Indicator fixed in the air-pump cover.

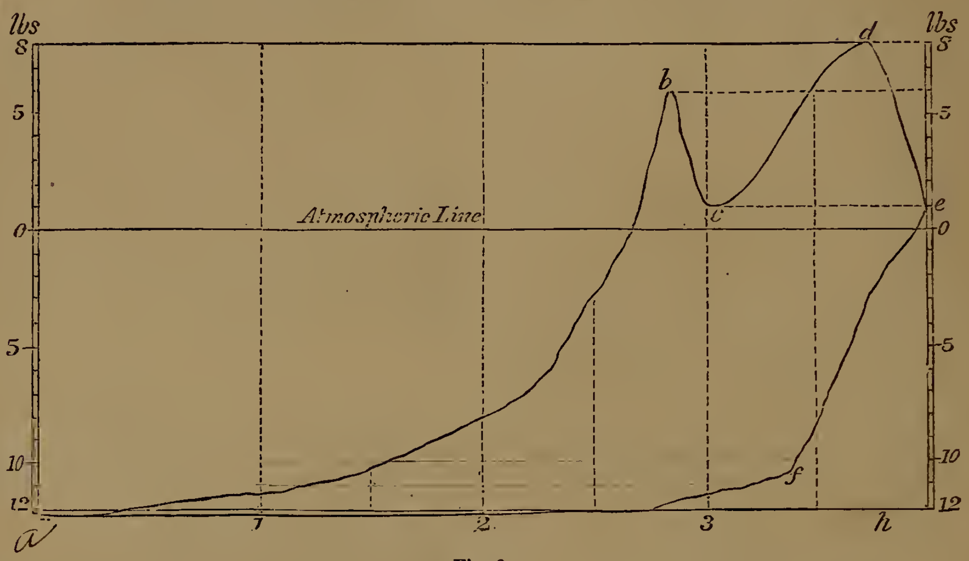

Fig. 2.

Indicator Diagram taken with the Indicator fixed in the cylinder cover.

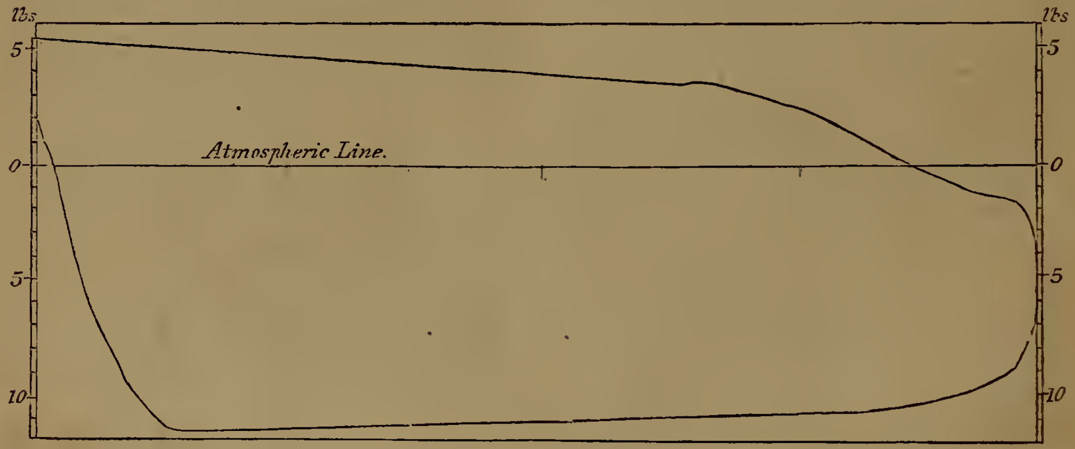

Fig. 2 is a diagram taken from the cylinder-cover of the same engine, and at the same time.

As we may suppose that the pressure below the air-pump bucket was pretty nearly constant at about 12lbs. below the atmosphere, which is the minimum pressure exhibited by the indicator, it is evident that the pressure opposing the upward motion of the bucket at any part of the stroke is measured by the height of the pencil at that part above the line *a* plus the weight of the water lifted at each stroke by the bucket. Dividing, therefore, the length of the stroke into eight equal parts, and taking from the indicator diagram the average pressure on the bucket during each, the calculation of the power necessary to work the air-pump, independent of friction, will stand thus:—

Pressure on bucket during 1st eighth	0lbs.
do. do. 2nd do.	0½
do. do. 3rd do.	1
do. do. 4th do.	2
do. do. 5th do.	6
do. do. 6th do.	13
do. do. 7th do.	15½
do. do. 8th do.	18
	8)56
Mean pressure per square inch....	7lbs.

Of course we must deduct from this the pressure acting on the bucket during its descent, as that assists the motion of the engine. This pressure, as given by the indicator diagram, is,

During the 1st eighth of the stroke	8½lbs.
do. 2nd do	1½
During the remainder of the stroke	0
	8)10
Mean pressure per square inch on the bucket during its descent	1·25lb.

We have, therefore, for the whole retarding pressure shown by the indicator, 7 — 1·25 = 5·75lbs. per square inch.

Besides this, there is the weight of the water lifted at each stroke to be taken into account. As the delivery-valve appears to open for the discharge of water near the point *c*, we may infer that the air-pump discharges about one-fourth of the capacity of its working-barrel full of water each stroke. The weight of this quantity of water is 394·5lbs. This divided by 1104, the number of square inches in the area of the bucket, gives ·357lbs. for the pressure per square inch produced by the water lifted each stroke. We have, therefore, 5·75 + ·357 = 6·107lbs. for the whole pressure opposing the upward motion of the bucket, after deducting the pressure which assists it in its descent. This 6·107lbs. again opposing its motion upwards, is equivalent to $6{\cdot}107 \div 2 = 3{\cdot}053$lbs. opposing its motion both ways; and as the capacity of the air-pump is about one-fifth of the capacity of the cylinder, a constant pressure of 3·053lbs. acting on the air-pump bucket is equivalent to $3{\cdot}053 \div 5 = {\cdot}611$lbs. acting on the piston. This, therefore, represents the portion of steam pressure expended in working the air-pump, exclusive of friction.

It would perhaps be rash to conclude that this is an *accurate* representation of the power expended on the air-pump in the generality of condensing engines; and it would be an interesting contribution to our knowledge of the internal working of the steam engine, if those who have it in their power would make a few similar experiments on different engines.

Art. XV.—ANALYSIS OF BOOKS.

A Treatise on the Principles and Practice of Levelling, &c. By Frederick W. Simms, F.G.S., M.Ins.C.E. Second Edition. London; Weale, 1843.

This work is not without its use to the beginner, and we recommend to his notice particularly the remarks on Instrumental Parallax at pages 20 and 35.

The author's recommendation to use an iron tripod is a good one, and an improvement upon the usual method of making the assistants carry a piece of stone to rest their staves upon. There are several other suggestions worthy of note, and the book is concluded with some tables which will be found of use in practice to facilitate numerous calculations.

The art of levelling, however, is so extremely simple, that in conjunction with a good instrument, nothing is requisite to ensure success but *care*, and many extensive sections have been made by men who never saw a book on the subject. We do not say this to undervalue treatises on levelling; if they can effectually inculcate this one great quality they are valuable, and we think Mr. Simms' book has this tendency.

Portefeuille de l'Ingénieur des Chemins de Fer. Par M. Auguste Perdonnet et Camille Polonceau. Paris: L. Mathias, 1843.

This is a work coming out in numbers, and which professes to give a summary of our knowledge relative to the structure and materials of railways. It would be premature to form an opinion of the work from the few numbers which have been as yet published; but in these numbers there is nothing which is not, we believe, familiar to every one pretending to know any thing of railway subjects. The plates are very good, though perhaps needlessly detailed.

Sur une Coloration particulière que presentent les Corps relativement aux Rayons Chemiques. Par M. Melloni.

This is a very extraordinary work and is the prelude, we think, to some grand discovery relative to the nature of light. From various observed photographic effects of light, M. Melloni endeavours to deduce the accuracy of the undulatory theory; and if he has not altogether succeeded, he has made a great step towards success. There are some anomalies not altogether reconcileable with M. Melloni's views in the present state of our knowledge. These he has reserved for consideration in another memoir, and when it appears we shall enter more minutely into the subject.

An Introductory Lecture on Pictorial Anatomy, delivered to the students of the Edinburgh School of Design. By James Miller, F.R.S.E., &c. Edinburgh: Adam and Charles Black.

The object of this lecture is to point out the importance of anatomy to those aspiring to delineate the human figure. This preparative, it is argued, is much more important in the present day than in the time of the ancients, both on account of the greater difficulty of obtaining models and the deterioration in the human form that has taken place in these latter ages. In these doctrines we concur; yet, as no good thing is without a drawback, we think too great an attention to anatomy will be very likely to give a certain air of exaggeration to the productions of its votaries. With them it will not be nature as she is, but nature so sublimated and overdone as to lose half her charms. The following observations on the productions of Michael Angelo are, we think, very just and are very well stated:—

"To the great Buonarotti no one will deny the merit of having carried ideal design to the loftiest pitch of daring. But whether the matchless intrepidity of his creations may not have seduced his imitators into sins of extravagance and exaggeration, may well be matter of controversy. Some votaries may have been consumed by the fire of the same altar which shed only its light and warmth upon more favoured worshippers. With his mighty genius, with his great experience and enthusiasm in art, and with his intimate knowledge of the Anatomy of the human frame, (for let not that be forgotten as one of the foremost of the qualifications of this great master,) he could not only venture to approach the verge of propriety, but occasionally to disport himself on the other side. While contemplating his wondrous creations, the spectator quails beneath their grandeur—he trembles as he adores—and although he acknowledges the commanding power of the mighty Tuscan, he still languishes for nature.

"In his earlier works, before the thirst for epic grandeur had taken undivided possession of his soul, we find that his conceptions are less overcharged, and harmonize better with the truth of Nature. Hence they commend themselves more warmly to our sympathies. Take, for example, the 'Dead Christ.' And who is there, rapt in this mysterious scene, that does not feel, that it is because the Son of God is here faithfully represented as suffering man, that our souls are touched with the softest and holiest emotion?

"In the latest works of the same master, when his daring genius had been tamed by the influence of advancing age, we find a greater degree of sobriety and chasteness of style. He himself perceived his brilliant errors. He also saw and lamented too late, the fall prepared for sculpture. Where he had trod with safety, his less gifted followers sank. By him, art had been placed on a proud, but dangerous height; from that it fell; and, after a few years of progressive degeneracy, it dwindled away into absolute insignificance,—just in proportion as the artists departed from Nature, and from the great masters who had copied her, to mould their works on academic rules and the phantoms of abstract perfection."

A greater importance perhaps has been attached to the study of the antique statues than such sort of discipline really deserves. It appears to us, that such works should rather be the means of *verifying* our conceptions, than of *forming* them. In the following remarks we concur:—

"But there are other reasons why long and careful study of the best models of the antique will not atone for neglect in the study of anatomy; nay, is even apt to mislead. The man who is ignorant of anatomy, seeing nothing but what is on the surface, and unable to explain it by the arrangement of the parts beneath, is apt to think he cannot do better than adopt it as his unvarying model, and perhaps reproduces it in an attitude very different,—when, of course, another set of muscles being called into play, another set of tendons and ligaments being put upon the stretch, the form of the part must materially change; and thus, what was truth and beauty in one attitude, now necessarily becomes deformity. On the other hand, the student of anatomy sees at once the cause of the form of the part and of the changes which it undergoes; or could even say, *a priori*, in a certain position of the limb, such and such muscles being in action, such being the shapes of the extremities of the bones, and such the disposition of the ligaments, such must be the form of the whole. I surely need not add, that, in the first case, even after years of labour, there must often be error, always difficulty; while, in the second, the labour is incalculably lightened, and the confidence of knowledge inspired; the one, in short, is an empiric, the other is a man of science."

It has often been a matter of enquiry, why, if anatomy be conducive to skill in art, we of the present day are not superior in art to the ancients, seeing that we are confessedly superior to them in anatomical knowledge? Mr. Miller offers the following explanation:—

"It may be objected, that if nature and its anatomy be the foundation, as thus alleged of true design, why are not the works of sculpture produced now, equal or superior to those of the ancient Greeks; seeing that, with an improved knowledge of anatomy, we have the same school open to us that was open to them; for Nature denies her instructions to none who desire to become her pupils. To this we frankly confess, that a knowledge of this science, however profound, is not enough, combined with *mere* nature,—we must have *beautiful nature*, on which to ground our conceptions of form; these we may mould together by means of our knowledge of the human structure; 'but it is Nature alone who combines them with perfect truth and delicacy, in all the varieties of motion and expression.' And there is little doubt that such nature as the Greeks possessed is not within the reach of modern artists.

"The body was then cultivated in preference to the mind. All had a taste for its beauty, and were anxious to improve it. Of the four wishes of Simonides, the second was to have a handsome figure. The youth, by manly exercise, were trained to full symmetrical developement; and the first rewards were decreed to those who excelled in agility and strength. Statues were often raised to wrestlers; and even the most eminent men in Greece sought renown in the gymnasia. Chrysippus and Cleanthes distinguished themselves there before they were known as philosophers. Plato appeared as a wrestler, both at the Isthmian and Pythian games; and Pythagoras carried off the prize at Elis. Children who gave promise of beauty, were allowed to contest for a prize, and he who won it had a statue erected to him. The Lacedemonian women kept in their chambers the statues of Nereus, of Narcissus, of Hyacinthus, and of Castor and Pollux, hoping, that by often contemplating these, they might have beautiful children. And both sexes were happily exempt from those dire attempts, too often successful in the present day, to change simple chaste nature into an unnatural thing of manner and affectation, as practised among our teachers of *accomplishments* in their various schools of deformity."

To all this must be added, the very imperfect means artists of the present day possess for observing the attitudes of the human figure, compared with those they could command in the time of the ancients. The wrestling ring and other places of athletic recreation afforded means of observing the action of all the muscles, such as cannot be obtained at the present time, and those very exercises at the same time contributed to make models for the artist. It is to the want of such exercises in the present day that the declension in the beauty of the human form is attributable; and, although anatomy may serve to correct some of those errors, we do not anticipate that the arts of sculpture and painting will ever reach the elevation among us they attained among the Greeks, until similar facilities for observing muscular action, and similar means of improving the human shape shall have been brought into operation.

Report of the Road and Street Cleansing Company. Manchester; 1843.

This is a pamphlet professedly recommendatory of Mr. Joseph Whitworth's Street-sweeping Machine, and its statements must therefore be accepted in the light of those of a confessed partizan. Yet the advantages of that machine are so numerous, and so manifest, that we do not see how any partial statement can materially alter its value in the public mind. The report is badly written;—people will not be content to state what they have to say in precise and concentrated language, but must enlarge on the benefits, moral, physical, and intellectual, of the scheme they advocate, upon all mankind, in all time coming. There is a great deal too much of that musty oratory in the report before us; we shall, however, give our readers an extract, which appears to be one of the parts least open to this objection, and to embrace many of the most important features of the plan.

"The process of street-cleaning consists of three parts, viz., sweeping, loading, and carrying. Under the present system, these are entirely distinct operations; each of them constitutes a protracted and expensive process, and the two former absorb a large amount of human labour. By the aid of the patent machine, all the three processes are not only carried on simultaneously, but, as it were, blended in one operation, whilst each is so far simplified, as to render the combination less complex and protracted, than the single process of either sweeping or loading by the present mode.

"By the present mode of sweeping, the dirt is first moved from the centre to the sides of the street, and there collected into heaps for convenience in loading. An immense amount of time and labour is thus consumed; the mass of dirt being moved over a wide extent of surface, and the operation of cleaning continually retarded by the accumulation. It is calculated that each particle, on the average, moves through twenty feet of space, before the operation of loading commences.

"Here the advantage of the patent machine is self-evident. It entirely supersedes the whole process just referred to. The dirt, instead of being swept from one part of the street to another, is swept at once into the cart, and the street is cleared effectually. The operation of sweeping, in fact, merges in that of loading, and both are performed without the intervention of human labour. When going at the rate of only two miles per hour, with brooms 3 feet wide, the patent machine will clean nearly 60 superficial square yards per minute. This is about the average rate of work done by 36 men.*

"While the machine is thus calculated to abridge human labour, it will have the effect also of reducing the number of carts and horses now required to perform a given quantity of work. The time at present occupied in loading and carrying is considerable, in consequence of those operations being performed under very unfavourable circumstances. That of loading must be suspended during the progress of the cart from one station to another, and, consequently, is perpetually interrupted. Horses and men are stopped and started alternately short intervals, whereby a continual waste is occasioned both of time and force. The operation of the patent machine, on the contrary, is uniform and uninterrupted. Hence, though taking less in width, it will go over double the extent of surface included in the progress made by the present cart during the same time. Moreover the diminished time occupied in loading is made available also for the purpose of carrying. By the present mode, the cart must stand idle while being filled, whereas the patent cart, not only combines the operations of sweeping and loading, but performs both in the act of moving forward to the place of deposit. Nor is this all; it also economizes the time now spent in carting away and returning empty. Under the present system, owing to the great width of surface from which the sweepings are collected, the cart cannot travel far without being filled, and hence the time is principally occupied in carrying merely. Probably two-thirds of the whole time of carts, horses, and drivers, are consumed, even where the places of deposit are adjacent. But the patent cart, taking less in width, (as before observed,) will proceed proportionably further before it is full. If the street be twenty yards wide, (the brooms being one yard,) it must go ten times further, and would reach a distant point by the time it was completely filled. Hence it may be practicable to make such provision for deposit within or near the district, as will save all the time now consumed in carrying. A very moderate number of depots would suffice for this purpose. If the streets were kept clean, by frequent sweeping in dry weather, the yards might be advantageously placed more than a mile apart, and the cart, passing from one to another, would continually carry on its three-fold operation."

The construction of Mr. Whitworth's machine we have mentioned in a former number. It consists in the application of a series of brooms to an endless chain, which passes over two barrels, one at the back of the cart, and the other situated very near the ground, in which situation it is supported by a suitable frame. These rollers being put into revolution by the cart-wheels as the cart is drawn on, carry the mud by an inclined shoot up into the cart. The machine, in fact, is a dredging machine with brooms instead of buckets.

Minutes of the Proceedings of the Institution of Civil Engineers.—London: Longman & Co., London, 1843.

It is not our intention to copy these minutes monthly into our pages, but we shall, from time to time, call the attention of our readers to any part of them we think worthy of notice. The business of the present year opened on the 10th of January with a paper of Mr. Davison's, relative to a well sunk by him at Messrs. Truman and Hanbury's brewery, and to which, we believe, we adverted in a former number. This was followed by a long mathematical paper by Mr. Mallett, of Dublin, relative to water wheels. The conclusions developed in this paper are the following :—

1st. When the depth of water in the reservoir is invariable, the diameter of the water-wheel should never be greater than the entire height of the fall, less, so much of it as may be requisite to give the water a proper velocity on entering the buckets.

2nd. When the depth of water in the reservoir varies considerably and unavoidably in depth, an advantage may be obtained by applying a larger wheel, dependent upon the extent of fluctuation and ratio in time, that the water is at its highest and lowest levels during a given prolonged period; if this be a ratio of equality in time, there will be no advantage; and hence, in practice, the cases will be rare when any advantage will obtain by the use of an overshot wheel greater in diameter than the height of fall—minus, the head due to the required velocity of the water reaching the wheel.

3rd. If the level of the water in the reservoir never fall below the mean depth of the reservoir, when at the highest and lowest, and the average depth be between an eighth and a tenth of the height of the fall, then the average labouring force of the large wheel will be greater than that of the small one; and it will of course retain its increased advantage at periods of increased depth of the reservoir.

It seemed to be the general impression among the members present that the results to be obtained by the improvements Mr. Mallett recommended, would be no better than those arrived at by the ordinary plan.

On the 7th of February, a long paper was read by Mr. Pole, relative to the comparative amount of friction in beam and direct action engines. The results he deduces, taking the beam engine as a standard of comparison are as follows :—

The vibrating engine	has a	gain	of	1·1	per cent.
The direct-action engine with slides	"	loss	"	1·8	"
Ditto with rollers	"	gain	"	0·8	"
Ditto with a parallel motion	"	gain	"	1·3	"

These results are probably correct, but indeed we hardly think the question worth the time and labour which seem to have been spent upon it.

During the present month the following papers have been read :—

An account of the various plans, projected and executed, for supplying Glasgow with water, by Mr. Machain, Engineer of the Glasgow Water Works. About the year 1780, it was proposed to bring, for the supply of the whole city, the water of a spring, which is now found inadequate to the wants of a House of Refuge, since erected near it. At that period, many plans were proposed, particularly one by Mr. Henry Bell (who subsequently introduced steam navigation to this country); he objected to steam-engines for pumping up the water, "because they would be a nuisance, and hurtful to surrounding property, and their consumption of coals would increase the price of fuel in the city." Mr. Telford was consulted, and on his recommendation two steam-engines were erected, with reservoirs, &c. His estimate of the requisite supply for a population of 80,000 persons was 500 gallons per minute; supposing that 6,000 families would become renters, and the produce, at 2*l.* each family, would be about 12,000*l.* per annum. The population in 1842 was 300,000, and the annual income was about 30,500*l.*, making the average payment about 9s. per annum for each family. The number of steam-engines has now been increased to *thirteen.* An account was subsequently read of a reservoir erected at Glasgow, for holding water for the supply of the new part of the city. It is situated nearly four miles from the water-works, and its height above the Clyde is about 106 feet. In order to take the utmost advantage of a limited space, the sides of the reservoir were made of cast-iron plates connected, with a floor composed of Arbroath pavement, fastened together with iron cramps, and the joints pointed with cement; it is supported upon consecutive layers of sand, clay, and rubble; the interior dimensions are 123 feet long, 85 feet 6 inches wide, and 11 feet deep, and the whole is covered by three wrought iron roofs, each of 28 feet 6 inches span.

A description was read by Mr. Baker, of the Water Pressure Engine, constructed by Herrn Brendel, at Freyberg. This engine is placed in the Alte Mordgrube Mine, at a depth of 360 feet beneath the mouth of the pit. The power employed is a column of water, which, acting alternately upon the pistons of two cylinders, (each 13 inches in diameter, with 9 feet stroke,) gives motion to 44 pumps, in two sets of 22 each, placed at an angle of 45 degs. with the horizon; the suction pipes of the highest pumps descend for 30 feet, dipping into the delivery cisterns of those immediately below them, and this is repeated downward for the whole series: thus raising the water to the point where it runs off by an adit. The engine requires little attention, or repair, and it is stated that the duty performed is as 70 to 100.

A drawing was also exhibited of a tank, erected by Mr. Arrowsmith at Malta, in the years 1841-2. It is the largest covered tank in Europe, and is capable of holding 15,000 tons of water. It is called the great Coradino Tank, and forms a part of the works now in course of erection for supplying Malta with water.

United Service Journal, Nos. 170, 171, 172, 173. London: Henry Colburn.

This, we think, is a very unequal work, interesting and exact in some of its scientific statements, but very unauthentic in others. The first number for the present year opens with a long-winded dissertation upon Atlantic Steam Voyaging, which is neither particularly well written nor manifests any very intimate acquaintance with the subject. All the stale arguments relative to Dr. Lardner's alledged assertion that a steamer could not cross the Atlantic, are reproduced and restated in new forms of dulness. It is hardly necessary to say, that Dr. Lardner neither did nor *could* have said anything of the kind, simply if there were no other reason because the Atlantic voyage *had already been made* by a steamer. He said, indeed, that the scheme *would not do*, and has it done? Those only can mistake Dr. Lardner's meaning who confound practicability with profit, and who will not understand, that a commercial scheme how practicable soever it may be, may, nevertheless, be unsuccessful.

We make no observation on the *taste* of the following, but merely would draw attention to its conclusiveness.

"Still the doctors differed as to the limits of this extension of steam navigation. Dionysius Lardner, a very triton among minnows, took the field with the magnanimous resolution either to burke the Great Western project, or so smite, as to cripple it. With this *luminous* fancy in view, he not only wielded the goosequill, but also sported his person in Bristol, where he held forth that, to attempt a voyage across the Atlantic by steam, was 'as vain as would be one to the moon.' Such was the *dictum*,—but the Bristolians, who are no fools on a march, marvelled that such a question could be raised, knowing well that our steamers had not only navigated the Mediterranean and the Baltic, but that the Atlantic had already been crossed, and India visited by way of the Cape. They therefore flew in the face of the schoolman's temerarious prediction, and fitted out the Great Western. As all the world knows the gratifying result, it is needless to say more than that she performed the voyage with such celerity, safety, and punctuality, as floored all opposition. Since then, her arrivals and departures are as decidedly fixed as those of a mail-coach; and it was only a few short months after the learned doctor's diatribe against the practicability of making the trip, that we saw in the very same room where the spouting took place, this placard:—

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* In the township of Manchester, 22,000,000 yards were swept during the year 1841. 60 sweepers and 20 carters were employed, of whom, say 67, were constantly occupied in sweeping or loading. This would give 1,000 yards per man per day. The labour of paupers is found to be much less effective.

"The Great Western, Lieutenant Hosken, R.N., Commander, is intended to sail

FROM BRISTOL,	FROM NEW YORK,
4th June,	9th May,
25th July,	1st July,
12th September,	18th August,
7th November,	10th October,
	8th December."

This, it must be admitted, is most conclusive; because the Great Western Company thought fit to put up a placard with the days of sailing upon it, therefore, the scheme was a good one! The President's time of starting was, no doubt, notified with equal exactitude. The following is not the fact,—leviathan vessels, such as the President and British Queen, are not so good as vessels of a smaller size.

"Experience had already shown the great advantage of large over small steamers, because the capacity and buoyancy of the vessel increase in so much larger a ratio than the resistance; but, in order to obtain sufficient room for carrying the enormous supply of fuel required for a voyage across the Atlantic, and at the same time to allow accommodation for passengers and cargo to a remunerative amount, it was necessary to build vessels of extraordinary size."

The proficiency in steam matters may be judged of by the following:—

"At her departure on the first voyage, the Great Western had on board 660 tons of coal, of which only 452 tons were used on the passage; and in several of her subsequent voyages the average consumption of fuel has been 27 tons a day. The experiments of Capt. Hosken upon the engines, to ascertain the speed of the vessel relatively with the degree of power applied, and the required consumption of coal, yielded these results:—

Power of Steam to the Square Inch.	Revolutions per Minute.	Miles per Hour.	Cwt. of Coals per Hour.
3½ lbs., or full steam........	15½	12¾	28
8-10ths of 3½ lbs.	15	12½	27
7-10ths ditto................	14	12¼	26
5-10ths ditto................	13	11	23

"These gradations were arrived at by the cramm, a part of the engine adapted to 'cut off the stroke' to any desired proportion, which is done by its action on one of the principal valves, in such a manner as partially to close it. The proof of the amount of pressure was shown by an instrument called the indicator, which was screwed upon the cylinder—communicating with it from within for the purpose, and which, by the action of the engine, most ingeniously given to it, described with a lead pencil upon paper a parallelogram, cutting off one corner, showing the precise vacuum in the cylinder, and by this the proportion of power applied. The engines were computed at 225 horses' power each; and their whole number of revolutions during the voyage was 287,324."

By the *cramm*, we suppose is meant the cam of the expansion valve, and the expansion is accomplished, not by *partially* closing the valve before the end of the stroke, but by closing it altogether. Then, who ever heard of "Cutting off the stroke?" These errors, we admit, are somewhat venial; but they at the same time suffice to show that the writer knew nothing of the subject. The following account of the Great Britain steam-ship, may, perhaps, interest some of our readers.

"From the high character given of the iron vessels hitherto constructed, the Great Western Steam Ship Company at Bristol determined upon a magnificent experiment. They resolved to build an iron steam ship of such dimensions and power as should as much surpass the 'Great Western' as that vessel had itself surpassed every steamer previously afloat; and this is now realized in the 'Mammoth,' *alias* the 'Great Britain.' We personally inspected every part of this huge vessel, as well as the working places around her, and were inclined, on examining the details, to listen with complacency to the confident boast that she should reduce the passage across the Atlantic to ten days. The builder, who unhappily died during her progress, was at every pains to proceed on a scientific principle, knowing that, otherwise, the greater her bulk the bigger her blunder. She is built entirely of iron, with the exception of the flooring of her decks and panellings of her cabins. The plates of the keel are from ¾ths of an inch thick in the middle to 1 inch at the ends, and all the plates under water are from ⅝ths to ½ inch at the top, except the upper plate, which is ⅝ths. She is clencher-built, and double riveted throughout. Towards the extremities, and quite aloft, the thicknesses are reduced gradually to 7-16ths. The ribs are framed of angle iron, 6 inches by 4½. The mean distance of the ribs from centre to centre is 14 inches, and all these ribs will be doubled; the distance is then increased to 18 inches, and then gradually to 21 inches at the extremities; 1500 tons of iron were expended in her construction. The boiler platform is of plate iron, supported upon ten iron kelsons, of which the centre ones are 2 feet 3 inches deep. These kelsons are formed, like the floorings, of iron plates, placed on edge. The hull is divided into five distinct compartments, by means of substantial water-tight iron bulk-heads. She has four decks, the lowest of which is of iron, and appropriated for the reception of the cargo; the upper deck is flush fore and aft; and the two intermediate ones are devoted exclusively to the passengers and crew. In this space are four grand saloons, two roomy ladies' cabins, and 180 state-rooms, besides the portion assigned to the ship's company. The principal saloon is 108 feet long by 32 feet wide, and 8¼ feet high. Besides the extensive space thus devoted to the *personnel*, she has sufficient room for the stowage of 1000 tons of coal and 1200 tons of measurement goods. There are three boilers, capable of containing 200 tons of water, which will be heated by twenty-four fires, and she has four engines, each of 250 horse power. She is fitted with six masts, on five of which a single fore-and-aft sail will be carried, the mainmast alone being rigged with yards and topmast. These masts will be low as compared with the size of the hull, although the mainmast is 95 feet long; and the quantity of canvass, however inconsiderable to what she would carry as a full-rigged ship, will still be as much as would cover three-quarters of an acre of ground. The full dimensions of the vast fabric are thus:—

Length of keel	282 Feet	Power of engines	1000 Horses
„ over all	324 „	Burthen	3200 Tons
Breadth	51 „	Displacement...............	3000 Tons
Depth of hold	32 „	Load draught..............	16 Feet.

"The boldest feature in the 'Great Britain' is her mode of propulsion, which is Mr. Smith's screw-propeller, by substituting which for paddles, she was relieved from 100 tons of top-weight, besides admitting of the boilers and engines being adjusted in that part of the ship which is best suited to receive them, and where they best act as permanent ballast. This adoption, by relieving her breadth from the unwieldy paddle-boxes, would also enable her to pass the present locks at Cumberland Basin, and discharge her cargo in Bristol harbour, instead of putting it into lighters at Pill. The screw is placed in the dead-wood of the counter, under the stern, quite out of the way of injury; and it can readily and quickly be disconnected from the engine, when sails alone may he required."

The only other extract we shall make from this article is, the following table, of the correctness of which, however, we are in no way certain.

Dimensions.		Great Western.	British Queen.	President.
Length, extreme	Feet	236 0	275 0	265 0
„ under deck	„	212 0	245 0	238 0
„ keel	„	205 0	225 0	220 0
Breadth within paddles . .	„	35 4	40 0	41· 0
„ over ditto . . .	„	59 8	64 0	64 0
Depth of hold at midships . .	„	23 2	27 6	23 6
Tons of space	Tons	679½	1053	......
„ of engine-room . .	„	641½	963	......
„ total	„	1340	2016	1840
Power of engines . . .	Horses	450	500	540
Diameter of cylinder . . .	Inches	73	77½	80
Length of stroke . . .	Feet	7 0	7 0	7 6
Diameter of paddle-wheels . .	„	28 9	30 6	31 0
Weight of engines, boilers, and water,	Tons	480	500	500
„ coals, 20 days' consumption	„	600	750	750
„ cargo	„	250	500	750
Draught of water . . .	Feet	16 8	16 7	17 0

The following upon the preservation of timber, we extract from the last number.

Dry Rot.—"A great outcry was raised against Sir Robert Seppings, for injecting coal tar into the interstices of the ship's frames, as a novel introduction which risked the destruction of the whole fleet by fire. Still coal tar is less inflammable than vegetable tar, and had been long in use, as may be seen in the Philosophical Transactions for 1666, where, speaking of the *teredo navalis*, we are told, 'There is in Holland a man that pretends to have found an admirable secret to remedy this evil. And a very worthy person in London suggests the pitch drawn out of sea coals for a good remedy to scare away those noisome *insects*.' But that profound senator, Mister Joseph Hume, prompted by one Good, loudly inveighed in the House against the *new* measure of injecting with coal tar, saying, that it *must* be very injurious to the iron and copper fastenings, as well as to the health of the men; and that moreover, 'it rendered the side of a ship so inflammable, that on the snapping of a pistol it would catch like wild-fire.' Now so far from its being considered injurious to the metals, it had been used to cover iron cables, and other iron works, as an excellent anti-corrosive; and no official complaint has been made as to the health of those ships which had been injected, except in the questionable one of the 'Pyramus,' which was refuted by Sir William Burnett, and the medical officers to whom the case was referred, as well as by a committee of the Royal Society. Yet that such a charge as the last should not go unrefuted, the Navy Board formally invited Mr. Hume and his prompters, to destroy the "Russell," a new 74 on the stocks, which had been profusely injected with coal tar. But all their attempts were equally vain and fruitless, for she was not to be set on fire by any fair or ordinary means. Even the sapient senator himself, after introducing a lighted candle, and firing his pistol among the saturated timbers, was satisfied that he had uttered—how shall we write it?—that he had uttered what was not the fact.

In the course of the inquiries and investigations which arose from the rot disasters, it was abundantly proved, that ships constructed with a mixture of woods from various parts of the world, have been of shorter duration than *homogeneous* ones; the chemical influences of some of their juices generating disease; the materials which rot, infecting and destroying those in contact with them. The oaks of Northern Europe being of a quicker decay, will destroy our native oak when placed alongside of it, in one-third of the time of its own natural durability, or when used by itself. The American oak and fir are still more perishable in themselves, and more destructive to ours. Although the appliance of green timber had been decried for ages, our wants compelled its use: but that which was brought from America, in the heated hold of a ship, was invariably covered over on being landed with a complete coating of fungus, and in that infectious stage of disease, was largely used in our royal dockyards, to the rapid promotion of dry-rot.

Oak was considered stronger than other timber, because gallic acid solidifies albumen,—the process so greatly desired by artificial means. The planks of the bottom of the Devonshire, 74, which ship was launched in 1812, were cut from the best kind of American white-oak timber that could be procured; but although the ship had not been employed at sea, they were found to be totally decayed in February, 1817. The Halifax sloop of war, built at Halifax of the several sorts of wood grown in that neighbourhood, as birch, red pine, and oak, was launched in October, 1806, and was found unfit for service, in January, 1812. When taken to pieces at Portsmouth, the birch and pine were found to be totally decayed; and the oak, although in rather a better condition, was still in a decaying or decayed state. These were "confirmations strong," of the prejudicial results of an extensive use of foreign timber. A little attention was then paid to that of our own growth. The Fisgard frigate, built in 1819, is constructed on the starboard side (with the exception of the plank under the line of floatation,) together with one-half of her beams, with timber stripped in the spring of 1814, and felled before the rising of the sap in 1815; and the larboard side with timber felled in its bark, after the sap had risen, in the spring of 1815. As the ship is now in ordinary, the result is yet for a future day.

A dogma has obtained among the Mateys, that if once the dry-rot gained such advance as to nourish parasitic fungi, the case was incurable: but here, as in many other cases respecting ships, they were utterly at fault. We have known excision, ventilation, and systematic cleanliness, very effective, when the vegetable fibre was still left. And there are notorious instances on a larger scale. The Resistance frigate accidentally sunk in Mahon harbour, while heaving down; but as she had been reported in an advanced state of dry-rot, with the surface of her timbers covered with fungus, she was suffered to continue under water for many months. On being weighed and sent to England, it was observed that all appearance of fungus had vanished, and she remains sound to this day, being now employed as a troop-ship. Nor is the instance a solitary one. The Eden, of 26 guns, was absolutely covered with fungus, a certain indication that dry-rot was well on the advance. On examining her condition, submersion was recommended, and she was sunk at Barnpool, near Plymouth, in November, 1816. When raised, in March, 1817, every token of disease had disappeared; and she afterwards served many years in the East Indies, West Indies, and South America; and after her return from Captain W. F. Owen's surveying voyage, when we personally inspected her, she was made receiving ship at Portsmouth, in 1833.

It was discovered, that premature decay in the contract ships was accelerated by the profuse use of ill-driven tree-nails, especially those made of American pitch-pine, a wood more liable to rot and decay than oak, and consequently very improper for the purpose. It was observed when the Shannon, Broke's own, was examined, that the oak tree-nails had destroyed the fir planking for two or three inches round the tree-nail hole. These circumstances deserve attention; for we consider this mode of fastening to be most excellent, under the proper conditions of being well-seasoned, well-turned, and well-driven; and we cannot but remember the admirable ones of the Royal William. Mr. Charles May, of the firm of Ransom and Co., of Ipswich, has just introduced tree-nails properly made, and greatly compressed; so that after being driven home, they partly swell from their contraction, though so gradually as never to split the wood, into which they are hammered.

It being noticed that the destructive power of fungi is greatly aided by their hygrometric property—the *merulius lachrymans* even distilling drops of water—recourse was had to heat, both natural and artificial. But in the course of these experiments, it could not be concealed, that the process of desiccation by exposure to wind and air had exhibited numerous and serious failures,—the surface often being without blemish, but the interior, or heart-wood, a vast and spreading sore. Sir Humphry Davy had considered that a solution of the deuto-chloride of mercury would be efficacious in preventing the growth of fungi; but as mercury sublimates at a low temperature, he thought the volatility of that body might vitiate the atmosphere around. It was therefore not tested until Mr. Kyan, who is said never to have heard of Davy's *obiter dictum*, took out his well-known patent. His attack upon dry-rot consists in combining the albumen of the wood with bi-chloride of mercury (corrosive sublimate), which from affinity it converts into the proto-chloride; and the wood is thus rendered insusceptible of the attacks of the fungi.

It is known that the active vitality of the tree is in the liburnum, through the vessels of which the sap ascends and circulates; but the principle of physical vitality, the albumen of the parent seed, continues to be present, though dormant, in the compactest tissue of the heart. To destroy the latent element, and extirpate the sleeping life of the concrete albumen, is the object of Mr. Kyan; and he declares that the primary cause of all vegetable fermentation is neutralized by the deuto-chloride of mercury. In this he is borne out by Dutrochet, who found that the only poisons which will prevent the appearance of fungi, are the oxides or salts of mercury; no other mineral preparation has any such properties. This observer ascertained that oxides of lead and tin hastened the development of fungi; those of iron, antimony, and zinc, were inert; and oxides of copper, nickel, and cobalt, although they retarded the appearance of fungi, yet did not prevent their growth in the end. The true principle of action in almost every antidote, we are taught, is affinity for the bane or poison to be neutralized or destroyed; and albumen is the main element of vitality, fermentation, and putrefaction. Now the white of egg is the simplest antidote to corrosive sublimate: and in like manner, when a solution of sublimate is applied to timber, it at once penetrates the albumen, and then flies to the heart-wood, combining with the albumen, whether in an active or dormant state, and kills it.

The Athenæum, No. 806—7—8.

No. 806 contains a bad article on Mr. Henson's Aerial Machine; the writer supposes that the great canvas frame is to operate as a parachute instead of as a kite. The same number contains an article relative to the cost of railways in this country—well written, though somewhat hypothetical and overpainted. The following extract is all we can afford to give:—

"We have said that want of faith in the capabilities of the locomotive engine has formed one important item in the expense of the English railway system. Engineers set out in their railway career with the impression that the locomotive was ill-calculated to climb up hill with its load, and that, therefore, to work with advantage, it must work on lines either altogether level or nearly so; hence mountains required to be levelled, valleys filled up, tunnels pierced through rocks, and viaducts reared in the air—gigantic works at a gigantic cost, all for the purpose of enabling the engine to travel along a dead level, or nearly so. But here, again, was want of faith in the powers of the locomotive engine. The locomotive engine can climb the mountain side, as well as career along the plain; for here, also, its wonderful quality of increasing its efforts with the emergency comes into play. We have already seen how, in running along the level, the engine's powers of production increase with the demand for them, and supply of steam increases in proportion to the speed of the engine; but so also does the power of propulsion increase with the load to be dragged, or with the steepness of the incline to be ascended. In proportion as the load is increased does the elasticity of the steam, as it issues from the engine, increase, and thereby is the strength of the blast which blows the fire so increased, as to generate more steam, and stronger in proportion to the severity of the work to be done. Thus the locomotive engine has been found capable of ascending hills of rapid inclination. A slope rising 1 yard in 220, or 8 yards in a mile, has been found hardly of sensible disadvantage in a railway; double that, or 48 feet or 50 in a mile, is quite practicable; and the parliamentary slope of a common road, or 1 foot in 36, by no means impossible to the wonderful powers of our present improved locomotive engines. It should, therefore, cease to be deemed impossible to adapt railroads to the face of the country. Those enormous works may be dispensed with, or greatly diminished, which were made for the purpose of making the way practicable to the locomotive engine; and the enormous expense which this erroneous view, this want of faith, has cost us in the past, may be saved us in the future. Engineers must resign their crotchets about optimum gradients,—must cut their roads as their tailors their coats, according to their cloth, and give to such places as will not pay for an optimum railway, such a railway as their means can afford or their traffic warrant. Instead of going through the mountain, they must go over it, or round its base, as they best can. We can no longer afford to erect costly monuments of the talent or ambition of engineers; we want plain, useful, profitable railroads, for the carriers of our goods and the drivers of our coaches; we want a fair speed and a moderate price: and that is all we wanted, or should have had, from the beginning; by which means we might now have had double the length of line, and a much larger revenue for the present amount of national expenditure."

No. 807 contains a good review of Allan Cunningham's Life of Sir David Wilkie. Sir R. Westmacott's Fifth Lecture on Sculpture, delivered before the Royal Academy, also given in this number, is learned, discriminating, and full of sound sense. The work of Lady Sale, relative to the disasters in Affghanistan, with a review of which No. 808 opens, will be read every where with intense interest. This number, also, contains a fair article on the proposed alteration in our metrical and monetary systems.

The Civil Engineer and Architect's Journal, No. 67.

This number contains but few original articles. It opens with an account of the Walhalla, an edifice erected at Ratisbon, by the king of Bavaria, for the reception of the busts of distinguished Germans. This paper is a long one: a large, perhaps the larger part of it consists of speculations relative to the mythology of the ancient Gothic nations in which Odin cuts a distinguished figure. This paper is by Mr. Woolley, and was read before the Institute of British Architects. Mr. Vignoles' Lectures are given from the Mining Journal, and Professor Cockerell's from the Athenæum. There is a very good communication from Glasgow, relative to Dredging Machines, commendatory of the practice of *radius cutting*. It is now the common practice to put cutters and buckets alternately in dredging machines. Where buckets alone are used, they will make a succession of trenches, with a ridge between; but when cutters are also employed, they will slice a paring all off the side of a bank, which the buckets will remove. By making the bucket-frame so as to admit of a lateral motion, and by applying suitable guys to draw the frame either to one side or the other, the breadth of the paring taken off the side of the bank, may be easily regulated.

The Architect, Engineer, and Surveyor. No. 39.

This work has very much improved under its new management. The original articles are all exceedingly well written, and display much proficiency in architecture. The first article of the present number is an account of the restoration of a building named Koenigstulk, (the king's chair,) near Coblentz, in which the seven Electors of Germany used formerly to meet for the purpose of electing the emperor. This building was erected between the years 1376 and 1392. There is also in this number a very good article on the Mural paintings of the School of the Fine Arts at Paris.

The Practical Mechanic and Engineer's Magazine. Part 19. Glasgow.

The present number of this pleasingly written work contains an interesting article on Dyeing, and a very good paper by Mr. Thomson, on Blast Furnaces, read four months ago before the Glasgow Philosophical Society. Professor Cockerells and Sir R. Westmacott's lectures are also given from the Athenæum. There is also a rather milk and water article on the Flying Machine, which neither says nor unsays anything, and leaves the question much as it found it. There are two large plates given, the one of Nasmyth's forge hammer, and the other of Whitworth's planing machine. The number of original articles are but few, but those there are, are, for the most part, very well written.

The Mechanics' Magazine. Nos. 1025-6-7-8.

Mr. Pilbrow's engine and the project of flying seem to divide the attention of the readers of this work at the present moment. On the latter subject there are a number of correspondents, each saying Mr. Honson's plan will not do, and insinuating the efficacy of some nostrum of his own; while others again as unequivocally imply, that Mr. Henson's scheme will do very well. Of the latter genus there is one, signing himself L. L., who takes us to task for some of our errors in the account we gave last month of Mr. Henson's contrivance. It may be worth while perhaps to devote a few words to this correspondent's puerilities.

In the hurry in which our notice of Mr. Henson's plan was written, (for it was only on the day on which our last number appeared that Mr. Henson's plan was made public,) we inadvertently, in one place, put the word "feet," instead of the word "yards." Any blame attaching to such an oversight we must be content to take, but surely such a mistake neither proves that our mode of treating the subject was erroneous or that we were disposed to be unjust towards Mr. Henson, the error being in his favour, if of any value at all in a notice which pretended to be not a scientific analysis so much as a popular illustration. The principle of investigation we pursued, is, we are satisfied, correct,—and if an error or two may have crept into some of the words or figures, we think L. L. is the last who ought to attempt to magnify such matters into importance, seeing how marvellously good he is at blundering himself. Thus he quotes us as making the total pressure 13·144 lbs. instead of 13144 lbs; and he makes 17·715 lbs. multiplied by the square of 45° equal to 28·460 lbs. Now, whoever before heard of multiplying by the square of an angle? If he means the square of the sine of 45°, how does he get 28·46 for the product? Again, how does he find the product of 8·234 lbs. by $\sin.^2$ 45° or $\sin.^2$ of any angle in the whole circle to be 13·44 lbs., or, how does he arrive at the assertion that "if these principles had been worked out correctly, the weight supported and the resistance to flight would each have been =

feet. lbs. lbs.
$4500 \times 17{\cdot}715 \times \sin.^3 45° = 28185.$"?

After all these blunders it is needless to say, that the result at which L. L. arrives is in no way chargeable upon us, and that his whole arguments indeed go for nothing; and, although we do not attach such importance to small errors as L. L. seems to do, we should have been thoroughly ashamed of ourselves if we had fallen into a tithe of the blunders of which L. L. has here been guilty. What we have said relative to the Aerial project in another part of the present number, makes it unnecessary to add any thing more, except to repeat, that the only error of which we as yet stand convicted is, that of having put "feet" instead of "yards," and that mistake is so obvious a one that it carries its own correction.

ART. XVI.—MARVELS OF THE DAY.

Steam Frigate "Rattler."—This is a vessel to which Mr. Smith's screw is to be adapted; and we anticipate from the application a full and fair trial of that very ingenious contrivance. The following are some of the principal dimensions:—

	Feet.	In.
Length, extreme	195	0
Length on the deck . . .	176	6
Length of the keel for tonnage .	157	9½
Breadth, extreme	32	8½
Breadth, moulded	31	10
Depth in hold	18	7½

Burden in tons, 888$\frac{34}{94}$.

The engines are by Messrs. Maudslay. The gearing by which the screw is to be driven has been made with great care and nicety. The teeth of the main wheels are divided into three steps—that is, they are cut in the direction of their length into three portions, each of which is placed a little before the other; the pitch being thus virtually divided into three parts. By this expedient a great equability will be given to the action of the gearing, and we anticipate that it will work with very little noise. The "Rattler" was launched from Sheerness dock-yard on the 12th inst.

Embossed Oak.—We have taken occasion to visit Messrs. Braithwaite and Co.'s warerooms, where specimens of this new mode of producing carvings in oak are deposited; and the inspection of these different specimens has left on our mind a strong impression of the capabilities and value of the process. Before we saw the quality of the work produced we had an impression that the product of a process akin to branding would be necessarily rude and unsatisfactory. This impression a visit to Messrs. Braithwaite's warerooms has removed; and we believe such a visit would produce a similar effect on all minds infected with the same prejudices. Messrs. Braithwaite's process, we ought to have explained, consists in forcing a piece of wood with great pressure against a red-hot die, by which means it receives almost as sharp an impression as metal will receive in a common stamping-engine. The surface of the wood is slightly discoloured by the operation, but this discoloration can easily be removed: in oak carving, however, the discoloration is rather pleasing than otherwise, as it gives the effect of age. There are two limitations which attach to the process as compared with ordinary wood carving:—there cannot be the same variety without an immense number of dies, and the operation of stamping does not admit of that high relief produced by under-cutting. The under-cutting, however, if desired, could be done by hand. We think this new mode of producing ornamental wood-work will be most applicable to the decorations of churches, to which purpose it has, we understand, been already extensively applied.

Papier Mache Ornaments.—We have also paid a visit to Mr. Bielfield's papier mache manufactory, and have formed, in consequence, a much higher idea of the powers of pasteboard than we before possessed. Some, indeed, of the ornaments formed out of this material are quite extraordinary. The capitals of Corinthian columns, for example, and other things of still far greater intricacy, are formed very beautifully out of it, while other articles again, formed of the same material, have a bold and massive appearance, such as conveys the idea of their being formed out of some less surprising building substances. Should this manufacture go on much faster, we shall certainly have pasteboard houses very soon. The chief advantage of the papier mache, however, consists in its applicability to small embossed works. Where delicate ornaments are needed, such as wreaths of flowers and other fragile things of that nature, it is far superior to wood carving, both in the delicacy of which the formation of the object is susceptible and the strength of the article when made.

Removal of another of the Dover Cliffs by explosion.—Our readers are, of course, aware that some of the cliffs in the neighbourhood of Dover, which stood in the way of the line of railway, have been overturned by the force of gunpowder into the sea. The last of these blasts which have been effected took place on the 18th inst. (April), under the management of Mr. Cubitt, engineer of the South Eastern Railway, at Lydden Spout coast-guard station. The mass of chalk removed on this occasion formed the base of the same cliff, the crown of which, to the depth of 90 feet, was blown off by a blast consisting of 7,000 lb. of gunpowder, on the 2nd ult. The present blast consisted of upwards of 10,000 lb. of powder, which was placed in fifteen cells or chambers, at proper distances along the base of the chalky cliffs about to be removed, and the conducting wires being properly placed, all were fired off at once, as on the occasion of the last blast, by an apparatus invented by the junior engineer, Mr. Hodges, which simultaneously communicates ignition by means of the voltaic battery to any number of wires attached to it, with a single motion of the hand. This blast, like the others, was characterised by the absence of noise or smoke, the only difference being, that on the present occasion a large quantity of chalk blocks and rubbish was projected in the air to a considerable distance seaward. The quantity of chalk removed it is impossible for us to say at present; for so dense a fog overspread the abyss below, that the eye could not penetrate from the top of the cliff to the bottom. It was clear, however, that the mines had done their duty, from the tremendous mass that has been thrown down. For some time afterwards, pieces of the cliff kept falling off, and it was expected that other portions would come down in the course of the evening. This explosion seems to have created quite as great a sensation as the great blast of Rounddown. In the Rounddown explosion, 18,500 lbs. of gunpowder were employed.

The steam-ship "Solway."—Our readers are, of course, all already aware of the loss of this fine steamer near Corunna, and of the disastrous loss of life by which that misfortune has been accompanied. We shall not recapitulate the long details of the calamity which are to be found in every paper, but merely shall make a few such brief observations as the occasion naturally calls forth. The "Solway" was one of the finest of the West Indian mail vessels; the mould of the ship was among the handsomest of them, and the rate of steaming superior to most of the others; the ship was built by Messrs. Scott and Sons, of Greenock, and the engines were by Messrs. Scott and Sinclair, of the same place. Both, we understand, were excellent specimens of steam-packet work. The vessel, from the time of her starting to the time at which she was lost, had been most of the time in the West Indies and had never required any repair. The "Solway," it appears, left Southampton on the 1st inst. She proceeded on her voyage without any thing particular occurring, and put into Corunna to deliver and receive the mails. After having left that port about two hours, all the passengers and most of the crew (with the exception of those on duty) being in their berths asleep and unconscious of their danger, the vessel suddenly struck on a rocky shoal, called the Baldayo, within a mile and a half from the coast, and, notwithstanding the utmost exertions were used by Capt. Duncan, the officers, and crew, the unfortunate vessel sunk within twenty minutes, in thirteen fathoms. Immediately on the ship striking, the greatest alarm and consternation prevailed; but poor Capt. Duncan, although so suddenly placed in this trying and distressing situation, behaved with the greatest coolness, judgment, and intrepidity. He was only anxious to save the lives of those around him, and appeared careless of his own so long as he could render assistance to those unfortunate beings placed under his care. He was last seen on one of the paddle-boxes, endeavouring to unlock and disengage the paddle-boat, to save those of the passengers and crew who had not taken refuge in the pinnace and first paddle-boat that had been launched, Under his direction the pinnace was first got into the water, and as many as it could conveniently hold were lowered into it, but the frail bark was not destined to reach the shore. From some cause still unexplained it was capsized, and every soul on board perished. The first paddle-boat was then lowered, and into that, also, as many crowded as possibly could, and, notwithstanding there was no oar to assist them, it managed to reach the shore in safety by paddling, &c. It is supposed that many went down with the vessel, there being no time to launch the other boat that is kept on the paddle-wheel, to save those unfortunate beings left on board. The vessel is sunk in thirteen fathoms water; this and the extensive injuries she received in the shock preclude the hope of her ever being raised. The mails have been lost and of course every thing else on board. It was our intention to have given an article this month relative to West India steam voyaging, but really the accumulated misfortunes of the Royal Mail Company are such that we cannot bring ourselves to any task which might involve a word of censure. We feel for this company sincerely, and we are confident that every rightly-constituted mind must sympathise deeply with its afflictions.

Jeffery's Marine Glue.—A paper has been read before the Society of Arts illustrative of the virtues of this composition, which is stated to be remarkably adhesive, elastic and waterproof. The following experiments were detailed, as having been tried at some of the Government Dock-yards, and if they are authentically given the composition must be one of much value:—Two pieces of African oak, 18 inches long by 9 inches wide, and 4½ inches thick, were joined together longitudinally by the marine glue, with a bolt of 1¼ inch in diameter, passed through each of them from end to end. The day after the marine glue had been applied, the blocks were tested by means of a hydraulic machine. A strain was applied to the extent of 19 tons, at which point one of the bolts broke, but the junction of the wood by the glue remained perfect. Two bolts of 1¼ inch in diameter were inserted on the following day, and the strain was again applied until it reached 21 tons, when one of the bolts was broken, the junction of the wood still remaining perfect, and apparently not affected. Another experiment was tried with two blocks of African oak, of similar dimensions, but bolted in a different manner, so as to apply the strain at right angles to the junction made with the glue at the centre. The wood split at a strain of 5 tons, but the joint remained perfect. The glue in one case was applied to elm; it resisted a strain equal to 368 lbs. on the square inch. This trial was made while the block was in a wet state, which state is considered most favourable for the effect of the glue. Several large pieces of timber were glued together and suspended to the top of the shears at the dockyard at Woolwich, at a height of about 70 feet above the ground. From that elevation they were precipitated on to the granite pavement, in order to test the effect of concussion; this wood was shattered and split, but the glue yielded only in one instance, in which the joint was badly made, and after the third fall. The cement mixed with poison has also been proposed as an application to the bottom of ships. For joining the pieces which compose *built* masts the cement appears to be peculiarly appropriate on account of its elasticity, and in several Government vessels it has been used for that purpose. It is, we suppose, some Indian rubber composition.

Power transmitted by Belts.—A paper, by Mr. Sang, has been read before the Royal Scottish Society of Arts, descriptive of a method of ascertaining the amount of force transmitted by a belt, and consequently the amount of power consumed by any machine driven by a belt. His method of finding out this, will be understood from the following explanation:—When we see a belt passed over two pulleys and look without any narrow examination at the motion, we regard the action as a very simple one; there is more in it, however, than appears at first sight. For the sake of clearness, let us call the driving-pulley the drum, and the other the pulley. The belt passed over them, whether plain or crossed, has two free parts, one of which draws and the other of which follows. If it were possible that no force were needed to turn the pulley, these two free parts would be in the same state of tension; but whenever any resistance is made to the motion of the pulley, the drawing part is distended more, and the following part less, than usual; and experiments show, that, within all practical limits, this change is exactly proportional to the pressure necessary for overcoming the resistance. As the movement proceeds, the distended part of the belt is lapped over the drum, and, so to speak, the contracted part is lapped over the pulley, so that the circumference of the drum moves more swiftly than that of the pulley; thus, if the distension be 1 in 100, for 100 inches of the drum there would only be 99 inches of the pulley passed over. The difference between the velocity of the drum and that of the pulley thus indicates the pressure needed to carry the drum round. Now this pressure, combined with the distance through which it acts, gives the force used; and hence, the simple difference between the distances passed over by the circumference of the drum and by that of the pulley is exactly proportional to the force; and we have only to contrive some method of registering this difference, in order to have a record of the total force transmitted by the belt. There may easily be contrived a variety of arrangements for showing the difference between the motions of the drum and pulley. Thus a pair of indicators may be fitted, one to each shaft so as to tell the total number of turns made by each; from this number, by help of the measured diameter, the distance passed over by each circumference can be found, and thus the element for knowing the force transmitted can be had. Or otherwise, and this perhaps is the most convenient arrangement, a light pulley, having its circumference one foot, may be brought to bear against the belt on the drum, and another against the belt on the pulley; if these light pulleys have counting gear attached, a simple reading off and subtraction will give the difference of distance.

These remarks will probably sufficiently elucidate the principle of the plan. The actual amount of force corresponding to a certain indication, must of course be ascertained by an independent method for the first belt, but that once ascertained, the amount of force due to any other indication, or any other belt of the same material, may be approximately computed, regard being had to the weight of a foot of belt. We look upon this expedient as one distinguished by great penetration, and by an ingenuity of the most refined description.

The Great Britain Steamer.—The "Great Britain" is rapidly approaching completion, and it is expected that she will be floated out of the dock in which she has been built early in July. The length on deck is 305 feet; breadth of beam, 50 feet 6 inches; and depth, from upper deck to bottom, 32 feet 6 inches; and she is of 3,500 tons, according to what is termed builder's measurement. The engines consist of four cylinders of 88 inches diameter, and their length of stroke is six feet. It is intended that the expansive principle shall be carried to a greater extent than has yet been adopted in steam vessels. The diameter of the propeller will be about 16 feet, and it will be driven by a chain belt, by which the speed of the first motion will be multiplied about four times. The frames of the engine are a combination of hard timber and wrought iron, arranged in a triangular manner, and connected firmly in every direction to the hull. The carpentry of the four saloons is in so forward a state, that the painters and decorators are already employed upon them. Of the 180 state or sleeping rooms, some are arranged for one person, the greater number for two, and a few large ones for families. There are two large boudoirs, or private rooms, out of which access is gained to a number of sleeping apartments. The kitchen, stewards' pantries, and other subordinate departments are situated at such a distance from the part appropriated to passengers, that the latter will not be incommoded with the heat and smell arising from cooking, &c.; and it is worthy of remark, that all this part of the vessel, containing the boilers and coal-bunkers, is partitioned off with iron, in such a manner as to render it fire-proof.

Ascent of the Aerial Locomotive!—We thought we had rung the knell of the aerial scheme, but it appears to have already risen from the dead. We have somebody now writing from Glasgow, saying that he has constructed a steam kite on Mr. Henson's plan—mounted from a hill in open day—flown a long distance, until an accident occurred to the machine, by which he and it were precipitated into the sea—that he was injured and rendered insensible by the fall—and that when he became sensible again, found himself in bed, surrounded with doctors and physic! That after all this it should be supposed the said half-assassinated person could sit and write a pleasant account of his aeronautic adventures, and transmit the same to the *Atlas* or *Herald* before a single breath of the affair could reach London from Glasgow through any other channel, when there are a multitude of letters daily from that place; and that London editors should be found to insert, and people out of Bedlam to believe in such absurdities, is a phenomenon really as lamentable as it is ridiculous. Putting aside, however, the absurdity of the scheme, there are two things we have observed in glancing cursorily over the narrative, which would be sufficient to show us that the thing had never been tried, and which shows, too, that the person who concocted the hoax was more eminent for his wit than his science. First, he says that the engine got slower and slower; and on applying the indicator, he found the circumstance was caused by the diminished pressure on the piston at that great altitude. Now if the engine be supposed to be a condensing one, the pressure of the atmosphere cannot affect the pressure on the piston; and if it be a high-pressure engine, the diminished pressure of the atmosphere will make the urging force on the piston *greater* instead of less, the steam remaining the same. Then, again, it is said, that in consequence of the weight not having been taken off the safety-valve when the engine stopped, the tubes of the boiler burst. But the very nature of a safety-valve is to open of its own accord, not to require weights to be lifted off to enable it to open; and although in some steam vessels the valve is sometimes partially opened, or "eased," as it is called, when the vessel stops, yet the operation is not a necessary one, and danger could not arise in any but a worn-out boiler from its omission. In ascending into the air, indeed, the external pressure on the boiler being less, the internal pressure, if kept at its first point, becomes relatively greater: but the atmospheric pressure is taken off the safety-valve in the same proportion as it is taken off the boiler shell; so that the steam-guage will stand in the same position at all altitudes, or, what is the same thing, under all variations of barometric pressure. But enough: we are ashamed to catch ourselves speaking seriously on a subject which is fitter for laughter than philosophy.

MISCELLANEA.—It is rumoured that measures are about to be taken for commencing the formation of a railroad connecting Holyhead with the Grand Junction Railway. Government have, it is said, hinted their willingness to aid a project which will enable the London mails to reach Dublin in sixteen or seventeen hours, and *vice versa.*——An explosion of fire-damp took place in Lamb Pit, near Whitehaven, on Tuesday last, by which several of the miners were burnt; all, we understand, with the exception of three, very slightly; and these, we are glad to learn, are fast recovering from the effects of the unfortunate accident.——From twelve o'clock on Sunday to the same hour on Monday 28,642 persons went through the Thames Tunnel; and since the opening upwards of 320,000.——The number of persons who visited the British Museum on Easter Monday was 18,432, being several thousands more than on Easter Monday last year. Notwithstanding this large concourse of persons, not a single case of robbery occurred.——In consequence of the late melancholy loss of life, in the case of Mr. Busfield, the Bude light is about to be erected in the centre of the Brunswick pier.——Mr. Taunton has exhibited and described to the Society of Arts his elaborately constructed umbrella, intended as a present from the Turkish Ambassador resident in England to the Sultan, its value being 500 guineas. The stick and frame generally are made of gold, and the handle of ivory, having on its exterior carved representations of military trophies. The silk is of Spitalfields manufacture, and worked; the pattern being a basket of flowers, which is repeated in each gore. Within the stick and handle are contained the following articles: a telescope, a watch, a pencil-case with watch-key, a case containing pencil points, a sun-dial, a thermometer, a botanical microscope, and a knife with two blades. The weight is 36 oz.——The Government is about to appoint a commission to inquire into the state of the metropolitan sewerage.——The depth of the shaft of the Artesian well at Southampton is 560 feet, the depth of the bore 350 feet, making the total depth 900 feet.——The Great Pyramid originally occupied an area equal to 588,939,595 superficial feet, or almost 13½ English acres, the side of the square being 764,424 feet. The original perpendicular height of this structure was 479.640 feet, and the total contents of solid masonry equal to 89,418,806 cubic feet, weighing 6,878,369 tons. Taking the masonry at only 1s. a cubic foot, including carriage, materials, and workmanship, the cost of such a structure would be 4,470,940*l.*——The loss which will fall upon the insurers of the Solway royal mail, in London and Glasgow, is estimated at 40,000*l.* The difference between this sum and 60,000*l.*, which, in round numbers, is about the value of the vessel, will constitute another item of loss in the accounts of the company. Of this 40,000*l.* about 30,000*l.* is distributed among the London offices, the underwriters at Lloyd's having fortunately escaped with very trifling damage. Glasgow, it is said, will suffer to the extent of about 10,000*l.*——We are gratified to learn that the funds and prospects of the Society of Arts have latterly greatly improved. At a special meeting, held during the present month (April), it was resolved that the grants of gold and silver medals should be resumed, and that honorary testimonials should be occasionally given.——A French journal gives an account of a new steam-boat, used for the navigation of the Rhone. In addition to the common paddle-wheels, there is a large cast-iron wheel, passing through the centre of the vessel, with spokes projecting from its periphery. This wheel rises and falls, to accommodate itself to the unevenness at the bottom, on which it always presses, and by its revolution it forces the vessel on. The object is to overcome the strength of the current with a moderate power.

PILBROW'S INVENTIONS.

AND IMPROVEMENTS IN THE STEAM ENGINE.

FIG 1.

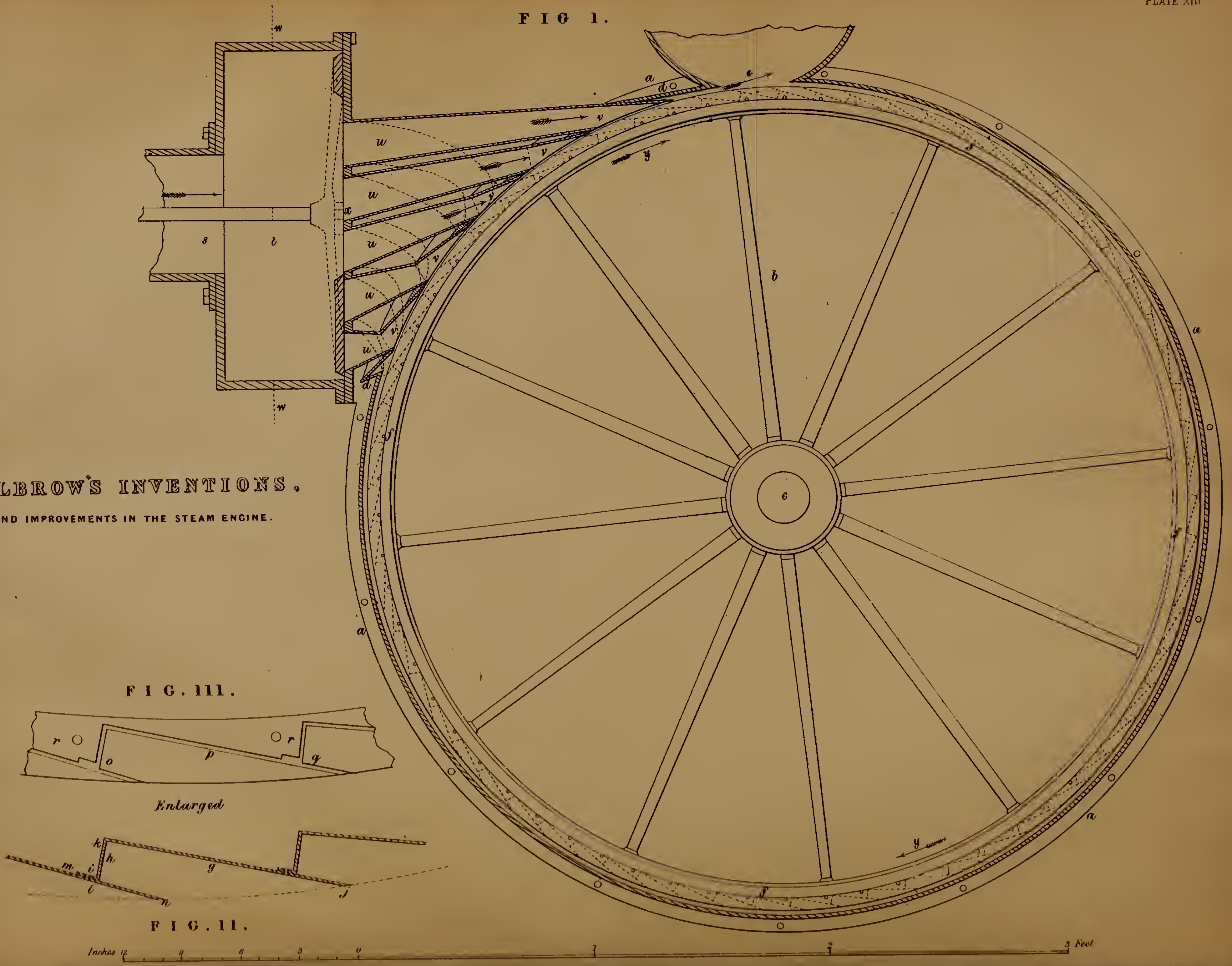
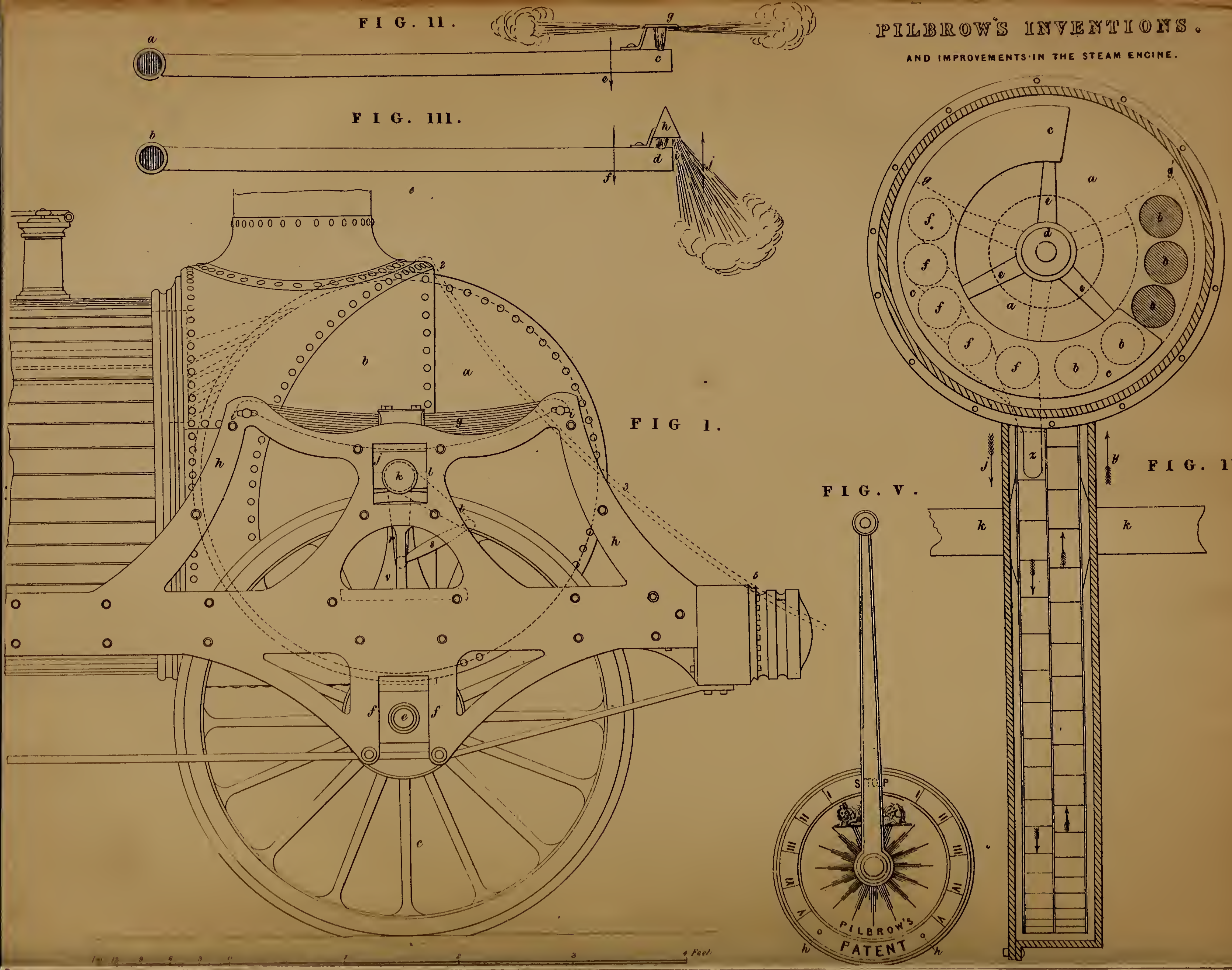


FIG. III.

Enlarged

FIG. II.

.R. Jobbins. 3. Warwick C.



PILBROW'S INVENTIONS.

AND IMPROVEMENTS IN THE STEAM ENGINE.

FIG. II.

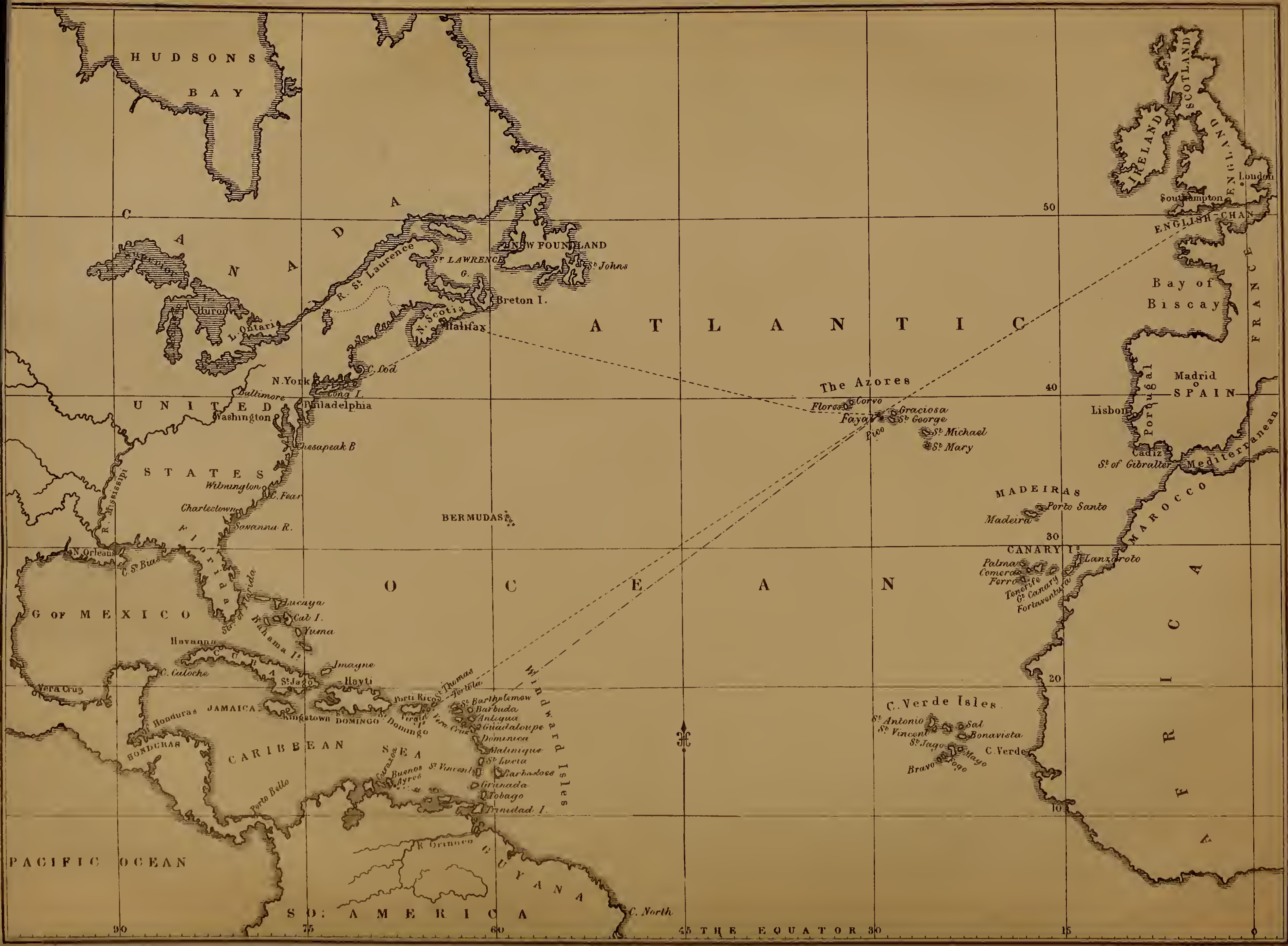
FIG. III.

FIG 1.

FIG. V.

FIG. IV

PL. XV



J. R. Jobbins, 3, Warwick Ct

Fig. 1.

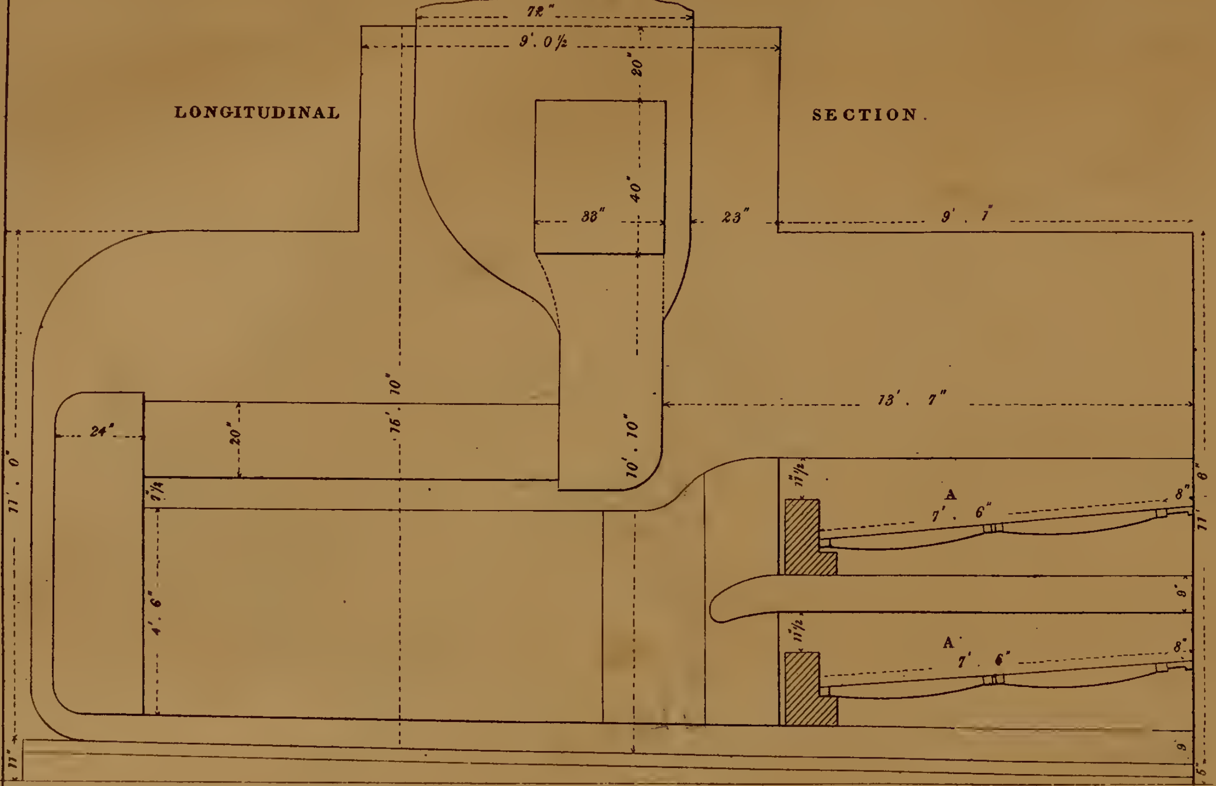


Fig. 3.

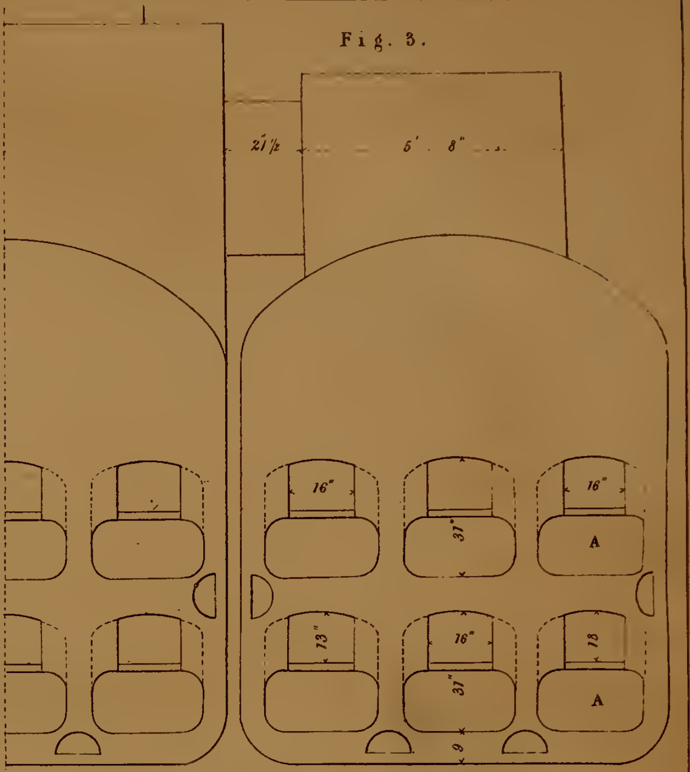


Fig. 4.

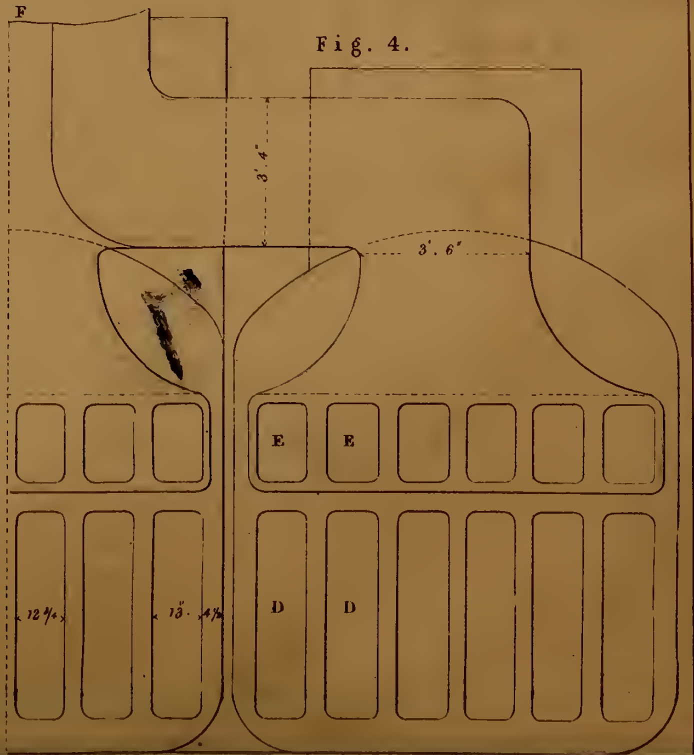
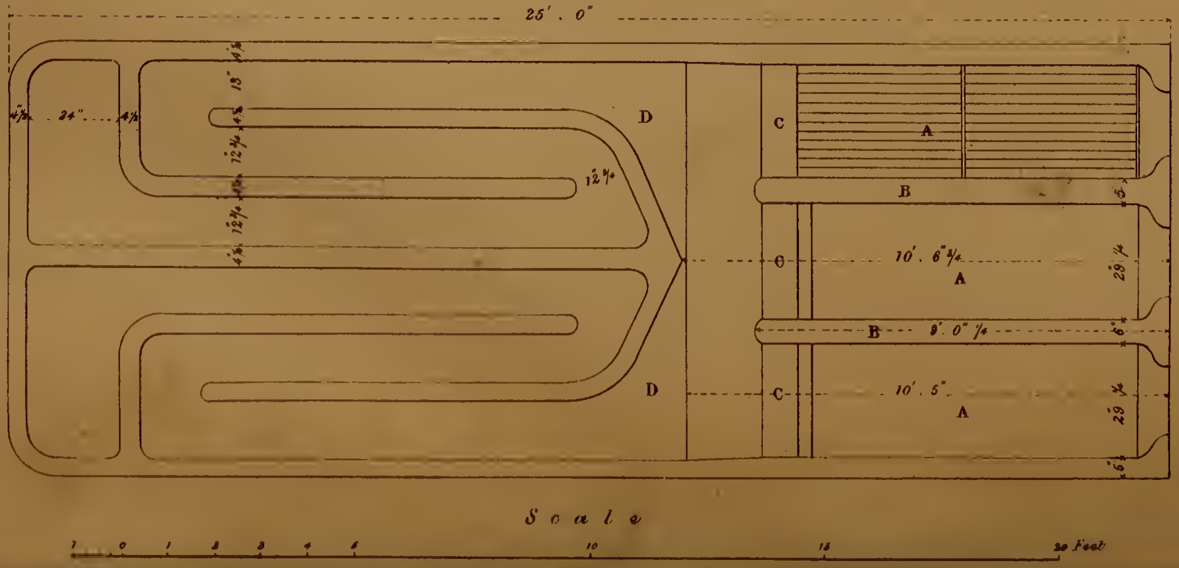


Fig. 2.



THE ARTIZAN.

No. V.—MAY 31st, 1843.

Art. I.—THE ROYAL MAIL STEAM-PACKET COMPANY.

The Directors of this Company have a heavy account to render; and every day they cling to office will only add to their embarrassment when the day of reckoning comes. The deplorable condition of the Company's affairs is universally known and admitted, and one and all agree that this condition is the effect of the grossest mismanagement. What, then, shall we say of those gentlemen who, in spite of this unanimous conviction—in the face of accumulating disasters, which only could have arisen from an utter want of skill—in defiance of the remonstrances and discontent of the Shareholders, and in contempt of the verdict passed by public opinion, of the total incompetency of their administration—persist, nevertheless, in holding fast an office, to the duties of which they are notoriously unequal; as if resolved to set at nought every principle of prudence and decorum, and to complete the ruin they have so skilfully begun?

We are sensible, indeed, that these Directors are 'all honourable men,' and that they have devoted much of their time to the service of the Company, without receiving any pecuniary recompense. Of their claims to indulgence on this score they have not neglected to remind the Shareholders; and certainly we have not the least disposition to withhold any credit due to such eminent philanthropy. But, amid all their sacrifices, there is one they have not yet had virtue enough to make, though it would be far more acceptable than all the rest; and that is, the surrender, without further loss of time, of their executive function. In spite of all their professions of disinterestedness, there seems to be a marvellous avidity on the part of these Directors for the pains of office, the secret of which we do not pretend to have yet discovered: but, at the several meetings which have taken place, it has been made sufficiently obvious that the Directors, notwithstanding all their protestations to the contrary, *do not* look upon their gratuitous services in the light of a burden or hardship which they have only consented to bear in compliance with the will of the proprietary. On the contrary, they have put their influence in force *to make a party* which might enable them to retain the executive power in their own hands; as if it were a thing to be intrigued or scrambled for, or exercised for the benefit of individuals. Whatever high motives the Directors may profess, this inordinate appetite for power *will not* be set down as the effect merely of a desire to benefit the Company: and the displays which have already taken place are, we think, calculated to encourage the belief that the interests of the undertaking are not the first objects of solicitude in certain quarters.

But, however this may be, it appears very plain to us that the Directors have no alternative left between the surrender of their executive function and the relinquishment of all pretensions to that high character, as merchants, they have hitherto succeeded in maintaining. The Shareholders went into the undertaking—or at least a large number of them—on the faith of the reputed integrity of the Directors; the faith, not merely that they were honest, and would not decamp with the collected capital, but that they would not take upon themselves duties to which they were totally unequal. Of this last offence, however, they have notoriously been guilty; and its operation upon the shareholders is just as injurious as if they had been guilty of the first. We do not, indeed, attach any moral delinquency to the act of which the Directors stand convicted; for the plea is an obvious one, that the assumption of the office for which they have proved themselves incompetent was the effect merely of an error of judgment in estimating the difficulties of the enterprize at too low, or their own qualifications at too high, a rate. But no such apology is available for the retention of office after the difficulties of the enterprize, and the unskilfulness of those aspiring to conduct it, have been made manifest to every party: and we are at a loss to conceive by what resource of ingenuity such a course can be reconciled with that high character which belongs to a British merchant, and which is sullied even by the suspicion of dishonour.

These considerations ought, we think, to have some weight with the Directors of this Company in inducing them to descend, while it is yet time, from their dangerous elevation, or at least in stimulating them to adopt some expedient by which the enterprize may have the benefit of an amount of skill equal to that enjoyed by other enterprizes of corresponding magnitude. Unless some such reform be speedily effected, the evils which have gone on accumulating will work their own reparation;—the Directors will be driven out with disgrace, and will be overwhelmed by odium and obloquy. This, we suppose, must be the event of the business; for the Directors even still have all the egotism and perversity of ignorance—the fearlessness which arises not from true courage, but *from not seeing their danger*. They were forewarned of the difficulties they have experienced even before their ships were built, but they spurned every advice, and laughed at every caution. They will adopt the same course, we are thoroughly persuaded, on the present occasion, and, to the end of the chapter, will probably justify the remark, that infatuation is the necessary precursor of ruin.

But, leaving the Directors to solace themselves with any vision of future prosperity that may please them best, and the emptiness of which experience must, we suppose, demonstrate, we must now proceed to offer a few remarks for the benefit of the Shareholders in this misguided enterprize, indicative of the course they ought, in our judgment, to pursue in the present posture of their affairs. To this intent, it will be necessary to review very briefly the past progress of the undertaking as indicated by the facts brought to light at the general meetings, and to ascertain how far the anticipations of the Directors have been confirmed by experience, or rather, perhaps, how far the Directors have earned a title to the gratitude and confidence of the Shareholders by their past management.

The vessels of the Royal Mail Steam-packet Company began to ply about the end of the year 1841, under a fixed arrangement with the Government. The first general meeting was held in September, 1842, and the proprietary then learned that the plan shown forth in the original prospectus, and on the faith of the prosecution of which many had gone into the scheme, had been abolished, and another established in its stead. They also learned that a loan of £260,000 had been contracted without their privity or consent; so that, in fact, the Directors appeared to think themselves entitled to make weighty organic changes without ascertaining the mind of the proprietary on the subject, although the charter gave them no such privilege. The new arrangement, however, entered into with the Government, was, we think, on the whole, advantageous to the Company. By the first arrangement, fourteen vessels were to be employed, performing a distance of 684,816 miles in the year, for which £240,000 a-year was to be paid: by the second, twelve vessels, performing 392,976 miles a-year, were accepted as sufficient; the rate of pay remaining the same.

The first accounts presented to the Shareholders have the appearance of being purposely mystified. They show, nevertheless, an excess of earnings over disbursements of £4,807, which, however, does not include insurance or wear and tear; and the Company, therefore, at the date of the first meeting, was left with a loss instead of a dividend. So far, then, the Directors had failed to realize their promises either to the Government or to the Shareholders. They, however, held out bright hopes for the future; the more important of which we must here compare with the results actually arrived at against the next general meeting. The first report says,

> "The Directors are of opinion that their receipts from passage-monies and freight, together with the £240,000 (which will be continued to be received from Government), *will be adequate for a dividend on the future operations of the Company.*"

Now let us see the amount of this dividend against the meeting of March in the next year. We quote from the report:—

> "The Directors present a balance-sheet of the affairs of the Company to the 31st December, duly audited, and also an analysis of the profit and loss account, which exhibits a loss of £79,790 16*s.* 9*d.*"

So that, instead of there being anything to divide at the second general meeting, the proprietary are comforted with the intimation that they have sustained a loss of £80,000. At the first general meeting the directors express their strong conviction that the new system will be worked with such regularity as to recommend the service to the favour of the Government and the public; and at the second general meeting the intimation is made that the Company has been fined in the sum of £3,500 for non-fulfilment of the Government contract. At the first meeting the following statement is made by the deputy chairman of the computed income and expenditure for the future:—

RECEIPTS.	
Through passengers . . .	£96,000
Colonial ditto	20,000
Freight of specie . . .	30,000
Parcels, &c.	12,500
Light goods	12,000
	170,500
Government vote . . .	240,000
Total receipts . . .	£410,500

CHARGE.	
Working expenses . . .	£235,000
Wear and tear, 20 per cent.	137,000
Total charge	372,000
Balance	£38,500

That is, an amount of £38,500 to be divided yearly among the shareholders. In the report read at the next meeting, however, we learn that the income cannot be estimated at more than £335,000; so that, with an annual charge of £372,000, this leaves not only no profit, but a loss of £37,000 per annum. This, be it remarked, is, according to the Directors' own showing: the actual loss it is impossible to make out from the accounts furnished to the meeting, which appear to be mystified for the purpose of concealing the true state of the affairs: but we are convinced the direct loss cannot be anything short of £50,000 a-year, independent of deterioration, and the risk run for property not insured. At the first meeting it was promised, on the part of the Directors, that persons skilled in steam navigation should be brought into the directory; but this, so far as we can learn, has not been done; and, at the last meeting, we find that the Directors who retired in rotation were again brought in.

It is needless to multiply examples of the inconsistency between the promises or predictions of these gentlemen, and the results arrived at in actual practice. Every act of their administration shows that their expectations have been too high even for the best management to realize; and it is not surprising, therefore, that, with the worst management ever known to steam enterprize, the result has in every case fallen infinitely short of the anticipation. At the first general meeting the prospect was held out, that, in consequence of the contraction of the routes, two vessels would be sold, by which a considerable sum would be realized. Up to the present time, however, not only has no sale been made, but vessels have been chartered, at an enormous expense, for the performance of the necessary service. Since the first meeting two more ships have been lost—an expense of £11,000 has been incurred for the repair of two vessels, in addition to the fine of £3,500 we have already mentioned, for the non-performance of the contract. This fine is the most disgraceful part of the whole business: it is, we believe, the first instance in which the Government penalty has been enforced. So far, then, from the affairs of the Company having undergone any of the improvement the Directors so confidently held out, they are now in an immeasurably worse condition than they were in at the date of the first meeting. Since that time the two vessels have been lost, and all the rest are older; and, in the ordinary course of things, are fast approaching to that condition which renders most expensive repairs indispensable. Out of the twelve vessels the Company now has, about eight are in a fit condition for running; the rest being either already under repair, or coming home for that purpose. Judging of the future by the past, the only criterion by which it can be judged of with safety, some more vessels will, in all probability, be lost within the year, some more vessels chartered, and some more fines imposed. Indeed, these latter contingencies become more probable as the number of vessels is progressively diminished. Then the expense of new boilers must shortly be coming on; for boilers of the magnitude requisite for these vessels must be commenced a considerable time before they are wanted for use: and, in the mean time, the repairs to the boilers and engines, as well as to the ships, must every month be becoming heavier. We cannot dwell, however, on these topics, and must now proceed to illustrate our position, that the Directors, by their mode of proceeding at the general meetings, have shown a most unbecoming eagerness for the retention of power. Their language is not that of the unbiassed representatives of a Company advising with their constituents respecting a common danger, but that of so many special pleaders, intent upon carrying things in a particular way. This, we think, will be made manifest by a few extracts from the speech of the deputy chairman, Mr. Colville, at the first meeting. We do not take this speech because it aims more particularly than the rest at being persuasive, but because it is a fair example of the proselyting spirit exhibited on the occasion.

> "Before concluding, I take the liberty of calling your attention to the consequences of coming to a *wrong* decision in this matter. I think that, considering the way in which the Government have treated the Company in this matter, and their readiness to further our views, that it ought to show us that it is but mere decency and proper feeling not to come to a hasty decision of stopping the service. We must be careful, indeed, not to do anything which may either suspend our proceedings or cast a doubt over the contract, for then we shall have all our liabilities come upon us, and we shall be obliged to sell our property prematurely, as there is no means of carrying on the concern unless our credit is upheld. Gentlemen may very easily think that they can sell up our property afloat, and put the money in their pockets, but they will find it very different. There is no market for such ships, except for that trade, for which only will they be bought, and a very small sum be given for them. Therefore our capital must not be estimated in reference to the cost of the ships, but what they will sell for. This is a fair view to take of the subject; and *if we apply the new estimate to the reduced capital, no doubt we can work profitably.* I am ready to confess that hitherto things have not been so well conducted as they might have been. Passengers have been left at Turk's Island, and detained on their route, and a prejudice against our ships created; and it is that irregularity which has operated so much against us hitherto: but if the service be performed regularly, and our duties to the Post-office properly performed, instead of steam navigation being in disfavour and disrepute with the Government and the public, we shall regain their favour; and, once established, the public will not allow the communication to be given up. Indeed, as matters stand, by trying the present plan for six months, the Proprietors must necessarily be in a better position to ask favours and to receive them. Looking at it, therefore, in every point of view, I sincerely trust that you will allow the arrangement with Government to go on: and I should be ashamed to belong to any set of men who could hesitate as to the propriety of carrying on the contract for six months: indeed, I will not believe that any gentleman holds such views. We must recollect that at present we have coal in the West Indies; while, if these stocks were to be sold, what market would be found for them? Were we to give up the contract, we should lose the Government money, and the passage-money, at the present period, when the people are all going to the West Indies. It would be, indeed, perfectly suicidical to abandon it."

We say nothing of the illusory nature of all these high hopes, or of how completely they have been dissipated by experience; and would merely call attention to the *tone* of this gentleman's oration, which appears to us to be that of a zealous partizan, and to savour more of the advocate or the enthusiast than of the calm and unbiassed arbiter. The speeches of all the Directors are pitched in precisely the same key; and their unanimity upon every point would appear to be the result of concert and predetermination. Among the shareholders there was, as might be expected, much difference of opinion; but in the directory there was no difference of opinion at all. According to the Directors, the Proprietors had only two courses open to them, a right and a wrong—the wrong being to appoint a committee to aid the Directors in bringing the affairs into some kind of order, or at least in ascertaining the the worst; and the right, in perpetuating the Directors' mismanagement. As to the solicitude professed for the Government in the matter, it is a mere flimsy pretext. The Government would be much more benefited, and, we have no doubt, sincerely thankful, if the contract were to be surrendered altogether. The same service was formerly performed by the Government without difficulty or disaster, and at a third of the sum paid to this Company for doing the service ill. Mr. Colville seems to suppose that the Company, by stopping short in its present ruinous career, would put its credit in jeopardy. We need hardly say how widely he is in the wrong; for there is no one, we believe, who is not of opinion that the credit of this Company would wonderfully rise on the supercession of the present Directors by competent and eligible persons. Mr. Colville, at the first meeting, asserted that the Directors had no desire to maintain their position, which was an onerous one, except for the general interest of the concern. Now we put it to these gentlemen, whether they *can* suppose that their remaining in office is for the good of the concern? Can they believe that their management has been as good as that of the General Steam Navigation Company, which is far more extensive, or that of the Peninsular and Oriental Company, the operations of which are more complicated and remote, or the Halifax Company, or the Great Western Company, or any other Company whatever? How, then, can it be to the advantage of the concern that these Directors should remain in office, when a management equal to that of any of these companies might be attained, and is, indeed, only now shut out by the present executive persisting in remaining in office? Mr. Colville has his choice between two things—between giving up his post as a Director, and being numbered with those whose acts and professions are not very curiously correspondent. We shall take care to ascertain to which alternative he is content to submit.

We must, however, give some more of the details of the first meeting. That meeting was adjourned, to enable the Proprietors to examine the accounts: and at the adjourned meeting, after the statement of Mr. Colville, which appeared to hold out better prospects for the future, the following resolution was moved by Mr. Poynder:—

> "The Proprietors having taken into consideration the report of the Directors laid before them at a general meeting, specially convened for the purpose on Wednesday, the 21st instant, and having heard the Chairman and Deputy Chairman on various points brought under their notice, beg to state that, whilst they deeply regret the losses hitherto sustained by the Company, and the consequent disappointment to the Company, yet, confiding in the opinion expressed by the Directors in their report, 'that the receipts from passage-monies and freights, together with 240,000*l.* which will continue to be received from Government, *will be adequate for a dividend on the future operations of the Company*,' and which opinion was confirmed by the Chairman in his address to the Proprietors, they do not think it expedient to advert further at this time to their losses; but being fully impressed with the absolute necessity, and great national importance of maintaining and upholding a steam-packet communication at this crisis with the British colonies in the West Indies, they deem it advisable to urge upon the Court of Directors to persevere in their endeavours to perfect and accomplish the great objects for which the Company was established; and they respectfully suggest to the Court to avail itself of the further assistance of such professional persons as are most experienced in the machinery and construction of vessels navigated by steam. The Proprietors also trust that, in future, the Directors will convene a public meeting of the Company once in every six months, and lay before them a report of their proceedings, and a statement of accounts made up to the latest period. And influenced by these considerations, the Proprietors now beg to assure the Directors of their earnest desire to co-operate with them in every laudable endeavour to advance the prosperity of the Company, and the great national interests involved in its success."

This resolution was seconded by Mr. Barclay, M.P., who excused the Directors for their numerous errors, and maintained that though a personal friend to many of the Directors, his defence of their misdeeds was not the consequence of that connexion. In reference to the want of technical skill on the part of the Directors, he is reported as having spoken as follows—we quote from the *Railway Magazine*:—

> "Gentlemen, Mr. Colville has told us that the vacancies in the Direction will be occupied by gentlemen professionally acquainted with the duties and management of steam navigation, and I am sure that it is a communication which must be most gratifying to all; for notwithstanding the abilities and high commercial

> character of our Directors, it is no disparagement to them to think that had they enjoyed the benefit of that assistance, such errors as we, in common with them, have deeply to regret, would not have occurred."

Several of the Proprietors having expressed their utter want of confidence in the Directors, Mr. Liggins commenced a very able and temperate speech in the following words.

> "I rise to address you with my mind deeply impressed with the importance of the subject, and I feel it some disadvantage to address you after three gentlemen, one certainly a friend of the Directors; and although dissatisfied with the resolution which has just been submitted to you, I trust that I shall obtain credit with the Proprietors for being animated towards the Directors with the most friendly feeling, of which I hope in the course of these proceedings to give proof. Although it is my intention to move an amendment on the resolution submitted; yet, Sir, I do claim, for myself, to be animated with the same friendly disposition towards the Directors, which these gentlemen themselves have manifested towards them. I again state, on behalf of my friends, that we are acting unanimously with a most friendly feeling towards the Directors, and that we are desirous of assisting them in devising any means of benefiting the concern."

After going into a number of important details, and pointing out with much sagacity the causes of the Company's ill success, expressing too, his belief that Mr. Colville's estimate of income would not be realized, an opinion since fully confirmed by the event—Mr. Liggins proceeded to say,—

> "Our present income is stated at 211,696*l.*, and if we add at the same rate for the remaining four months (105,846*l.*,) it will give us an annual income of 317,544*l.*, showing a deficiency on the original estimated receipts (604,089*l.*) of no less a sum than 286,545*l.* When we find so large a sum in the original estimate deficient, and that so large an amount of work is now to be given up, when we find our sources of revenue so much diminished, I think you will concur with me in the amendment I am about to move, 'That a Committee of seven Proprietors, three to be a quorum, be appointed, to inquire into the present state of the Company's affairs and its future prospects, and to report the results of such investigation to a meeting of the Proprietors. The said Committee to have power to call for persons and papers.'—(Cheers.) If anything can show a proof of my good feeling towards the Directors, I trust it is this, that if the meeting should be pleased to yield their assent to this measure, I mean to propose that the Chairman and Deputy Chairman should be members of such Committee. In submitting this proposition it may be necessary for me to observe that there are three parties now present, one composed of personal friends of the Directors who support the resolution before us; there is a second party who declare that they wish the affairs of the Company to be wound up, and with that party I hold no fellowship, I entertain no feeling in common—(cheers)—and there is a third party, that for which I now address you, who think that in the subsoil of our affairs there are the germs of future success, and the elements of prosperity are within our reach, but who feel that to effect this there must be, what is a strange word on my lips, *a radical reform.*—(Cheers.)"

Mr. Liggins was replied to by one of the Directors, a Mr. Cotesworth, whose speech is a piece of special pleading from beginning to end, and is plausible just in the proportion in which it is disingenuous. Whoever before heard such sophistry as the following, out of the mouth of a man meaning honestly?

> "Hitherto the greatest disappointment we have had is, that the result of the last eight months of working has left us no provision for wear and tear; *but that is of little importance* as to the actual wear and tear now, while subsequent prosperous working will enable us to redeem this, and to provide an adequate fund to keep up our capital and working stock."

We do not think any one can doubt of the Directors' having conspired to make a party for keeping themselves in office, after the following exposition.

> "The honourable gentleman surprises me by coming forward *to oppose us;* he must, by his own experience in the Southampton Dock Company, know the difficulty of keeping within estimates, and the many occasions on which he has had to explain excesses of estimates to his Proprietors, in order to reconcile them to further calls, alleging that their principal source of revenue would be derived from our steam-ships, and that the West India Steam Ship Company would be their best customers, *and I am therefore at a loss to know what secret spring* can have impelled the honourable Proprietor to take the course he has indulged in this day."

Such insinuations as are contained in the latter part of this tirade, are in our judgment perfectly disgraceful. Are Proprietors, because they may desire such arrangements to be carried into effect as will give the enterprise in which they have embarked their money, a chance of succeeding, to be therefore charged with having been actuated by factious or corrupt motives. It would be very easy to retort upon Mr. Cotesworth, the imputation of a 'secret spring,' and most of our readers will, perhaps, conclude that without some such supposition his wrestling and solicitude to be indulged with a continuance of his 'onerous duties,' is quite incomprehensible; but we have no desire to follow Mr. Cotesworth's bad example, in attributing motives to any one; and indeed, have no need of an artifice unknown to honourable warfare, and which is the last resource of a desperate and unholy cause. It is sufficient for us to know that this enterprize has from the very first been grossly mismanaged—that it is mismanaged still, and lies without any hope of amendment, so long as it is in the hands of the present direction. The Directors, we do not doubt, feel that they have damaged their reputation:—they perhaps assumed power to gratify a vain ambition, and now retain it to retrieve the errors they feel they have made. But this they will never be able to do—every day they remain in office only makes the position of the Company so much the worse, and they have no right whatever to attempt to vamp up their damaged reputation at the Shareholders' expense. There is one course only that the Directors can pursue with honour, and that is by giving the management of the Company's affairs into skilful hands, and continuing under the new administration to exert any influence they can command in the Company's behalf. If they either pertinaciously adhere to office, in spite of the universal opinion of their incompetence, or throw up their powers in anger, and afterwards wreak their revenge upon the undertaking, because they are no longer at its head; their characters will have a stain fixed on them, which they will never be able to wash away; and which will exclude them for ever after, from that high position in the commercial world they have hitherto, we hope, deservedly enjoyed.

But, however deserving the acts of the Directors are of reprehension, there are some of the Shareholders whose conduct is more censurable still. These persons, who of course cannot be supposed to be actuated by 'a secret spring,' yield not their assent merely, but their advocacy to whatever the Directors may think fit to determine on; and in the fervour of their zeal, appear to overlook the necessity of a little consistency and common sense. At the last meeting Dr. Bowring's proposition, that an adjournment should take place in order to enable the Shareholders to examine the accounts, was opposed by a Mr. Moxon, and others of his cloth, on the ground that there was a paragraph in the report, which held out the hope of improvement, and that the plans of the Directors had not been sufficiently tried, to indicate whether they would do or not! Now, Mr. Moxon can hardly be supposed to have been ignorant, that all the previous hopes held out by the Directors had proved delusive. At the preceding meeting, a resolution of confidence in the Directors was carried by Mr. Poynder, on the faith of a passage in the report, which expressed a conviction that the income "would be adequate for a dividend on the future operations of the Company," but six months afterwards, when the Proprietors assembled, not only was there no dividend, but there was a debt—a direct loss of £80,000. The expectations held out by the Directors in their last report, will prove equally deceptive; and as to their plans having been insufficiently tried, we are at a loss to conceive how a year and a half's experience does not as fully prove their badness as a century's. It is such reasoners as Mr. Moxon, that have been the bane of this undertaking—they frustrate the achievements of all reform, while reform is yet possible; and add to the weight of that responsibility, by which the Directors are already oppressed. In the idea that they are favouring the Directors, they are in fact, the Directors' greatest enemies; for in their endeavours to disguise, or palliate any just cause for discontent, they are only heaping up a load of odium, by which the Directors must eventually be overwhelmed. There is nothing more certain, that in any enterprize in steam navigation, the result whatever it may be must one day become apparent. It may for a brief period be kept secret, and if unfavourable may be excused on the score of difficulty or misfortune; but such resources cannot last long, and the event must stand out in its true colours. The truth in short *will not hide*, and it is idle to attempt it.

There is one great fallacy which appears to have pervaded the deliberations of the Shareholders of this Company, and which we think, has been a serious obstacle to the achievement of a thorough reform. The fallacy to which we allude is the belief that a change in the direction would be the means of breaking up the Company, and bringing about a sale of the property at a vast sacrifice. Now, the alternatives between which the Shareholders have to choose, are not the relinquishment and prosecution of the enterprize, but the maintenance of bad, and the introduction of good management. It does not at all follow that, because the Shareholders desire a change of management the scheme must therefore be given up, or their property brought to an unfavourable market, and the Shareholders should keep this important distinction steadily in view. The question is not whether the enterprize shall or shall not be given up, but whether the management shall be a good or a bad one.

We shall be told, indeed, by Mr. Cotesworth and his co-adjutors, that they are now very good managers, having had the advantage of several months' experience. But such a declaration will, we believe, meet with only a small degree of credit, seeing that these same gentlemen thought themselves perfectly competent before they had any experience at all. But of what weight is a few months of such experience as any of these Directors can have acquired? Other companies have the experience of twenty years, and what is far better, and without which a millenium of experience should go for nothing, the managers of those other companies have given proof that they are equal to the performance of their functions. We shall be told too, of the prospect of an increased grant from Government, but in the probability of such a grant we have no faith. The finances of the country are not in a state to justify it, and even if they were, we do not see how this Company has earned a title to such a mark of favour. Had the enterprize been well and economically managed, and still proved unprofitable, there might be supposed to be some ground on which a plea for an increased grant might be based—the importance of the maintenance of the communication having been first made manifest. But if a Company which has been notoriously mismanaged is to be granted an increased payment, on account of the absence of profit, every Company with which the Government has a contract, has only to mismanage its affairs to earn a claim for an increased allowance.

In a former number, we stated our conviction of the expediency of uniting the Royal Mail and Halifax Companies, to which we would also add the

Great Western Company, and of making Fayal the pivot of a combined range of operations, embracing the West India islands in the one direction, and New York and Halifax on the other. It is needless to recapitulate what we then said, but we may state that, maturer consideration has only strengthened our conviction of the goodness of the plan we then proposed, and that we are more and more satisfied, that Atlantic steam voyaging to be carried on with profit, must be carried on in some such manner as we suggested—unless indeed, a grand discovery be made in steam power, which will of course change correspondingly all existing conditions. The fusion of three unprofitable companies into one, might make a Company which, under good management, would be highly profitable and successful—just indeed, as in the case of the union of the Peninsular and Transatlantic Companies, neither of which were very profitable separately, but out of which has sprung one of the most flourishing Companies of the present time. We think the Shareholders of the Royal Mail Steam-Packet Company should at once ascertain what can be done towards such a combination. To this end they should appoint a Committee of their own, of which we should suggest that Dr. Bowring be made the chairman; and it should be the part of this committee to ascertain in what condition the Company really is, and what steps can be taken to make it flourishing. We do not think that this Committee should interfere in any way with the administration of the Company, or indeed, have anything to do with the Directors; but it should meet frequently to receive evidence relative to the posture of the Company, and to learn the opinions of persons the best skilled in steam navigation, as to what should be done in the existing circumstances. The shareholders have among their own number many experienced engineers and mechanists, highly competent to give a sound opinion upon the more important points, as well as numerous nautical and naval men, whose opinion would be of the utmost service. The evidence of all these persons should be got, as well as the evidence of others if it can be had, who have nothing to do with the Company, but whose known experience in steam navigation makes their opinion of value. This evidence should be all gone into in the parliamentary way, and a report founded thereupon, which should embrace some specific plan of reformation; to be brought forward at the next general meeting. The evidence, report, and plan, should all be printed and circulated some time before the meeting takes place, so that the Directors as well as the Shareholders might have time to prepare any objections to it that occur to them, and that no one might have a pretext for saying that the Committee was actuated by factious motives, or that the Directors were taken by surprize. The Shareholders would thus come to the general meeting with full information of their true position, and with a specific plan of improvement in their hands, and the sophistry and artifice would then indeed require to be great, that would succeed in defeating their purpose.

It will be objected to this plan of procedure, by some few persons, that it would be indecorous towards the Directors; that the past misfortunes of the management may not occur again; and that such an evident disunion between the Shareholders and Directors as this course would exhibit, would put the credit of the Company in jeopardy. Now we may ask these objectors if they really mean to pretend that the Shareholders are called upon to stand by without a murmur, and see every farthing of their property sacrificed because it might hurt the feelings of the Directors to arrest the work of destruction? Is this their position? The Directors showed very little concern for the feelings or fortunes of the Shareholders when they refused a committee of co-operation, though so earnestly solicited; and, indeed, we cannot see how in any way the Directors have earned a claim, either upon the Shareholders or any one else, to tender and protective treatment. The Shareholders in fact, have no alternative left them between the adoption of this plan, and utter ruin; and disagreeable as the course may be it is certainly the least of two evils.

As regards the *misfortune* from which this Company has suffered, it is only another name for mismanagement, or rather perhaps, more properly the fruit of that vigorous tree. There is no reason for supposing that any of the vessels would have been lost, if judicious courses had been laid down, and the captains and crews had been equal to their duty; for the loss of every vessel has been accompanied with evidence of the grossest incapacity and want of discipline. The appearance of dry-rot in the vessels, again, is due either to the appointment of incompetent inspectors, who let bad material be put into the ships, or of incompetent managers, who have permitted the ships to run without proper means of ventilation. The infliction of the Government penalty of between three and four thousand pounds is another *misfortune* as evidently due to mismanagement as either of the preceding; and the most cursory survey will show that the whole of this Company's disasters are the offspring of one grand and fundamental evil. In well-managed companies such misfortunes are unknown, and in this Company they will continue to arise with as great an uniformity as any other phenomena of the system so long as the present bad management is perpetuated.

The last point we think it necessary to notice in connexion with the course we have suggested, is the effect the formation of a Committee of the Shareholders would have upon the credit of the Company. Those who maintain that the want of confidence in the direction which such a step would indicate, could not fail to shake the Company's credit, start on the assumption that the existence of the most perfect confidence is now generally believed in. But is such a position for a moment tenable? On the contrary, is it not known universally that the great bulk of the Shareholders have no confidence in the direction at all, and, in short, that the whole management, from beginning to end, is in the worst possible odour, both with the proprietary and the public? In such a state of things the Company's credit must already be at the lowest ebb, and the hopes of intelligent persons would be revived, and the Company's credit best recovered by the manifestation on the part of the Shareholders, of a resolve to be deluded no longer, and of a full and firm determination to put the enterprize, without further trifling, upon a true basis. It is essential to the success of this improvement, and to the restoration of public confidence, that the reform should, as Mr. Liggins characterized it, be a *radical* one. The old management must be extirpated root and branch, some of its elements may again be available, but no negotiation should be entered upon with the existing managers in their official or corporate capacity. The present servants of the Company would probably be, for the most part, re-eligible, and certainly we think it would be both cruel and unwise to make changes, except where the unfitness was most glaring. But the new arrangements, to be successful, must be unobstructed by any which were previously in force, and the whole be begun *de novo*.

Such, then, is our opinion of the course the Shareholders of this Company must pursue, if they desire to retrieve their affairs or avert impending ruin. An amalgamation of the several Atlantic enterprizes, and the realization of the most skilful management that is to be had, are both, in our judgment, indispensable conditions; and there is no proposition, however obvious, which carries to our mind a clearer conviction than that it would be vastly better for the Shareholders of this Company to sell up their property at once, and wind up the concern, than to put up with any management which was not of the best description. Good management, however, is perfectly attainable, and if an amalgamation of this Company with the Halifax and Great Western Companies were brought about, the skill which has been made manifest in the conduct of those establishments might, no doubt, be rendered available for the new undertaking. A committee of Shareholders could not, however, open negotiations with those Companies on such a subject, and the present directors are certainly not the persons for the task. We, therefore, think it should be one part of the Shareholders' plan to appoint a provisional directory, under whose auspices negociations with other Companies might be opened, and any steps taken which due consideration might suggest. We also think that the active management should be vested in three or four managing Directors, who should be paid for their services, and whose only business it should be to conduct the affairs of the Company. The Court of Directors should be, not an executive, but a controlling power. It should be its business to see that the managing Directors did their duty, and the Secretary should be the servant of the Court.

We have neither room nor inclination to say more; nor can we suppose it necessary that we should do so. There is, probably, not a single unbiassed Shareholder in the whole Company, who is not of opinion that it is high time something should be done; and we think we have said enough to convince the less untractable of our readers, that the course we have suggested is feasible and expedient, and offers, indeed, the only road of escape from impending destruction. Unless it be adopted soon, its adoption will be impossible, for, before long, there will be nothing to save; and we therefore do trust that the Shareholders, for their own sakes,—for the sake of the Directors, who will never recover from the reproach, if the enterprize expire in their hands,—for the sake of the enterprize itself, which is a noble one, and which we should regret to see extinguished without having had a chance of succeeding,—will at once make a movement in the right direction, and adopt the steps by which alone these calamities may be averted. The past has been a continued succession of disasters, and the future presents a prospect still more gloomy. If, with an unreduced capital, with new ships, with a high character, and unbounded credit, the enterprize has failed to answer, what is to be expected of it when the capital has been diminished, the ships already on the verge of age, expenses of repair increasing, character ruined, and credit almost gone? To crown all, there are now fourteen magnificent vessels upon the point of being started, by the French Government, to the very same ports, and how long can this Company exist in the face of such a competition? No one will go in their ships, if they can have another mode of conveyance: they are universally complained of by passengers, as being dirty, disagreeable, and not safe. The cabins are ill arranged, and badly ventilated; the provisioning unsatisfactory; the persons on board uncivil; captains either tyrannical, or without command, depending on the amount of their influence; officers either ill used or disobedient; and the whole nautical government a combination of waste, rudeness, and insubordination. Then, again, passengers are afraid of being starved, or shipwrecked, or left upon a desert isle; and although some of these sources of dread have, we believe, been latterly lessened, yet the dread itself still exists, and will send passengers to other conveyances. In short, this Company has acquired so bad a name that the injury arising therefrom will for some time continue, even after the cause for it has been done away; and we think the discredit under which it rests, to say nothing of bad arrangements, will send the great bulk of passengers by the French vessels—especially if, as we suppose will be the case, they are to call at Southampton. In addition to all this, it must be borne in mind, that the French Company, being upheld by the Government of that country, is a much more formidable competitor than if it were the offspring merely of commercial enterprize. If it were a commercial undertaking, it would cease to exist so soon as it was fully ascertained that it could not be prosecuted with profit; and as there is not the least chance that it will be profitable, its relinquishment might be anticipated at no distant period. But, being the offspring, not of commercial adventure, but of national ambition, it will continue to be upheld, though attended with much loss, on the same principle that large fleets and armies are maintained, although they produce nothing. This will, of course, be looked upon, by all intelligent men, as a most ill-judged procedure on the part of the French, inasmuch as it must be a great drain upon the country, without the production of any corresponding advantage. But that is their concern; and it is sufficient for us to know that a commercial enterprize cannot compete with one which is independent of the conditions of profit and loss, and is kept up for the purposes of vain glory. The English Company, indeed, may say that it has a claim upon the Government on the ground of having benefited the country, and having shielded the Government from the expense to which the French Government is subjected by the creation of a fleet suitable for the purposes of warfare. But, if such a claim be admitted, what is to hinder every other steam company from coming to the Government on the self-same plea? The supposition, too, that this Company has benefited the country is a complete delusion. Nothing is more certain than that unsuccessful commercial enterprizes are as positive a loss to the country as if so much money had been thrown into the sea; while they, at the same time, bring on a stagnation in trade, by the discouragement they throw upon adventure. Instead of being a blessing to the country, this Company has been a severe and unmitigated curse. It has damaged the whole steam property in the kingdom, in the public eye; and has conduced, most powerfully, to heighten the distress by which our artizans are weighed down. Our engineers are all idle; and what is the reason? Simply, that bad enterprizes in steam navigation have inflicted such a wound on public confidence, that nobody now will have steam vessels built. The injury, direct and indirect, this Company has inflicted, is beyond calculation; it has been productive of benefit to no one; and we do sincerely trust that the Shareholders will at once take such steps that the Company will either cease to be, or cease to be a grievance.

EXPLANATION OF THE MAP.

The vessel, on leaving Southampton, would proceed to Fayal, with the North American and West Indian mails. At Fayal she would meet a smaller vessel, bound for the West Indies, to which she would deliver the West India passengers, parcels, and mails; and she would then proceed to Halifax, and from thence to New York. The West India vessel would proceed from Fayal to St. Thomas, or such other of the West India islands as was fixed upon for a station; and the mails, passengers, and merchandise should from thence be distributed among the islands, by means of small iron steamers, or fast sailing packets. It would probably be expedient to let the vessel from England proceed to North America and the West Indies alternately, the supplementary vessel running, at the same time, alternately between Fayal and North America, and Fayal and the West Indies, so as to keep up both lines. By this expedient, too, a continuous communication would be kept up between the West Indies and New York. But the expediency of this and numerous other points is only to be determined by experience, which is the only safe guide in such cases. Antigua has many advantages over St. Thomas as a terminus; we have shown the route to that island by a dotted line.

We stated, in a former Number, the advantages and disadvantages of Fayal as the entrepôt of this commerce, and have now nothing to add on that subject. The plan has, no doubt, its disadvantages, as every plan must have; but, taken altogether, it appears to us to furnish the only means of enabling our Atlantic steam voyaging to maintain its ground, especially in the face of so formidable an opposition.

ART. II.—PASSENGER CARRIAGES FOR RAILWAYS.

Specification for a Third Class Carriage. Manchester and Leeds Railway.

THE carriage to be the same in all respects as the pattern-carriage, to which reference must be made. The whole of the body and carriage is to be made of well-seasoned ash, except the carriage sides, which may be made of well-seasoned foreign oak, if more convenient than ash. The body is made separate from the carriage, or, under frame, and is bolted thereon. The length of the carriage, including the buffer, is 9ft. 6in., the width is 6ft. 2in., all outside measure. The length of the body is 14ft. 6in., the width 7ft., height 3ft., with a railing of iron 6in. high round the body. The foregoing dimensions are all outside measure. The following are the dimensions of the timber body: bottom sides, 6in. wide by 2¾in. thick; end bottom bars, 3½in. in width by 2¾in. thick; the other bottom bars, seven in number, 2½in. square; four corner pillars, 3¼in. wide at the foot, and lightened to 2½in. square. Ten other standing pillars between ¾in., and lightened 1½in. from the seat upwards. Stout corner plates all fixed to the foot of every pillar, likewise ash battens placed between each pillar. The middle rail on either side, 2½in. wide and 2¼in. thick. The top rail, 2½in. and 1½in. thick; ten straight standing pillars to frame the seat rails into 2¼in. square, lightened to 1½in. from the seat upwards; five seat rails 2½in. wide by 1¾in. thick; corner plates to be fixed on the top of each seat rail to take the standing pillars; five uprights of ash to be fixed under each seat to support them, 2½in. wide by 1½in. thick; the ends of the centre seats to have a flap to let down when required, so as to make the whole length of the body available for seat room. Seat boards are each 14in. wide on the sides of the body; the centre double seat is 2ft. 4in. wide, with a back rail to rest against, 2¼in. wide by 1½in. thick, supported at intervals by five uprights of ash, 1½in. square, properly tongued and grooved; the bottom bars are framed the thickness of the boards below, and the bottom bars are let into the carriage sides for a support, the ends of which are neatly concealed with a moulding placed underneath the bottom sides running from end to end of the carriage sides. The front protection board at ends of body, is composed of ten uprights 2¼in. square, with six strong corner plates extending the whole width of the platform up the corner pillars and the two centre pillars. The middle rails, 2¼in. square, top rails, 2½in. wide by 1½in. thick; four doors, one at every corner of the body, door pillars 2½in. wide by 1½in. thick. Top of doors, 2½in. wide by 1½in. thick; door bottoms, 2½in. wide by 1½in. thick; middle rails, 2½in. wide by 1½in. thick. The doors to be provided with strong brass hinges, double joints, and with outside brass door handles, with spring catch, &c., and safety hooks, &c., as per pattern-carriage. The whole of the pannels to be of pine, very dry, ½in. thick, free from knots and shakes, to be well seasoned before put in, and properly canvassed when in.

The carriage, or under-frame.—The sides of the under-frame to be made of one piece running the whole length, 10in. deep by 3in. thick; the end bars of the same dimensions; the cross bars, in the centre, 3in. square; the upper bars, on which two of the body bars rest, is framed an inch below the top of the carriage side to receive the bottom of the body. These bars are 2½in. wide by 2in. thick; the diagonal bars, and also the centre bars, are 3in. square; the diagonals are to be placed 6in. from the carriage sides in the corner, to allow the wheels to work. The block in the centre of carriage, 13in. wide by 3in. thick. The buffers, it will be seen, are composed of two pieces of ash, one of which is placed inside and the other outside the carriage sides, and secured thereto with bolts. The diameter of the buffers is 10in.; the cushion is a pad of leather 6in. long, properly stuffed with horse-hair, and secured to the buffer blocks with plates of iron screwed on. The draw-spring is composed of ten plates of ¼in. steel, 2′ 10″ long; the draw-rod plates, &c., connected therewith to be the same as in the pattern carriage. The whole carriage to be finished with axle guards, roller boxes, corner plates, steps, bottom plates, &c. The bearing springs the same length as the pattern, composed of 11 plates of ¼in. steel, 3in. wide. The whole of the wood work, as well as the iron work, to be properly put together with good white lead, and properly secured. The painting to consist of two coats of lead colour and two coats of dark olive green, to be properly picked out, and to receive two coats of good varnish. The inside to be painted with two coats of dark drab. The wheels, axles, axle boxes, &c., will be furnished by the Company, which will have to be put under and properly painted by the contractor.

ART. III.—THE ANALOGIES OF ARCHITECTURE AND POETRY.

THE elegant arts have all their origin in that deepest and most mysterious of fountains—the human heart. Like streams descending from the same perennial spring, they sometimes wander over the plain in widely divergent channels; but, for the most part, they hold on their way in parallel courses, and, by a thousand lateral branches, are perpetually intermingling their waters. Some of these streams may, in certain cases, be dried up, while the rest continue to flow on with undiminished activity; but, generally speaking, a change in the force or volume of any one of them will correspondingly affect the residue, and the tide of all will ebb or flow together. The vicissitudes of some one of the fine arts may thus be indicative of the condition of the rest, and may serve to connect that condition with causes to which it is not obviously referable. Analogies, it is true, are not proofs; but they will often suggest proofs to the imagination, or at least a method of obtaining them: and we think a true conception of architectural or any other art must be materially aided by the numerous and diverse lights which a wide range of analogies must necessarily throw upon it. The analogies subsisting between architecture and poetry are neither so numerous nor so strong as those which are to be found in some other departments of art; nevertheless, they appear to be susceptible of a developement calculated to clear up much that is mysterious in architecture, and productive of much curious and useful information. Such a developement, however, would be an undertaking incompatible with the limits to which we are at present restricted, to say nothing of obstacles of a still weightier kind; and we must content ourselves with a few scattered and hasty hints, which constitute the whole we are now able to offer.

It is, we believe, very well ascertained that metrical preceded prose composition: and the cause of this remarkable circumstance has been, with great plausibility, supposed to be a desire to distinguish the fruit of thought and reflection from the frivolities of ordinary conversation. Before the invention of writing, the only expedient by which it seems possible careful composition could be distinguished from vulgar discourse, consisted in the adoption of some peculiarity significant of art and premeditation, and which, by the difficulties it presented, might certify the skill of the person by whom those difficulties had been surmounted. It would appear, therefore, to be a natural event in the progress of society, that poetry should precede prose; and, by a reference to history, we find that in the early ages of the world even the laws were reduced to verse. Homer and Hesiod long preceded Herodotus; and in almost every country of which history has preserved to us any record, the oldest writers appear to be the poets. The most ancient buildings, too, of every country of which we have now any memorial, appear not to have been erected for any purposes of mere comfort or utility, but to gratify the passion of mankind for grandeur and renown, or to fulfil some object of devotion. In this way it appears probable that architecture flourished as an art before the erection of buildings for domestic purposes had made any considerable progress; so that in architectural as well as in literary composition, the difficult appears to have preceded the familiar and easy.

The architecture as well as the poetry of Greece, were the spontaneous produce of the soil, and both reached a pitch of excellence which has never since been surpassed. The science and useful arts of the Greeks were, no doubt, imported from the East; but their fine arts were an indigenous production. This is, perhaps, in a great measure due to the restricted intercourse which in early times subsisted between Greece and other parts of the world, as well as to the sentiment prevalent in that country, that every thing barbarian was unworthy of imitation. The Greeks studied no foreign language, and were unacquainted with any foreign literature; and their poetry was, therefore, a truer reflection of nature than if it had come to them through a thousand successive delineations, each inferior to its prototype in power and beauty. The Pelasgic ballads, like the ballad poetry of every nation, were the immediate offspring of the joys or sorrows or aspirations of the people; and these grew by degrees into the Epic, Tragic, and Lyric forms of poetry. There was no change in substance, however: the same opinions and the same emotions continued in unabated activity, and the Greek poetry remained as strictly national as when its minstrels knew little beyond the bounds of Attica and the Peloponnesus. In the most refined Grecian architecture, again, the insignia of a ruder era continued to be copied with scrupulous fidelity. The dovetails and iron hoops upon the columns, which were necessary in the original wooden buildings, continued to be copied in buildings of stone; so that, in the height of its perfection, the Greek architecture retained its primitive features—elevated and refined, it is true, but still unchanged in all its distinctive characteristics.

The Romans copied the architecture and literature of the Greeks; and both were to a certain extent modified by them. Any great change, however, must have appeared neither necessary nor desirable—the customs, climate, and religion of the two people being so nearly identical. When Constantine, however, after the introduction of Christianity, transferred the seat of the empire from Rome to Byzantium, the construction of a large number of churches became necessary; and as Byzantium had no pagan temples to supply the materials, an opportunity was afforded for distinguishing the Christian from the Pagan edifices; of which advantage was taken for introducing numberless innovations. The Roman basilicas, with their long vaultless avenues, were suppressed, and the form of the Greek cross, in the plan of the churches, was generally adopted. The ancient styles being thus fairly broken through, an infinite number of fantastic devices were adopted; and these, after a few centuries of gyration, settled into the Gothic style of architecture. In Rome, however, this revolutionary passion did not attain any high pitch; and there are no churches of note to be found there of any style intervening between that of the primitive basilica and that of the modern antique.

On the revival of classical studies throughout Gothic Europe, the poetry which had previously been representative of the true sentiments of the people, acquired an artificial and exotic character which it has never since entirely lost. Heathen gods and muses appeared in the poetry of Christian nations, and the democratic language of ancient republics was copied by feudal aristocrats. It was only the forms, however, of antiquity which were borrowed; the chivalrous spirit remained unchanged, but the dress and ornaments of classic ages were adopted, instead of new modes being permitted to spring spontaneously from existing sentiments and customs. Tasso's Jerusalem was in all its outward characteristics a Grecian Epic, but his heroes were Christian warriors and Churchmen, and throughout Italy, where this affection for antiquity began, an abundant introduction of Hellenic forms was looked upon as a mark of refinement. Concurrently with these indications, the architecture of the ancients began to be extensively introduced, and the construction of St. Peter's, and numerous other magnificent edifices, about this time, revived the affection for the architecture of the ancients throughout the nations of Europe. In England, however, the Gothic still continued to flourish, and our literature nearly up to the time of Shakspeare remained untinctured by foreign innovations. About the time of Elizabeth, fantastic combinations of chivalrous feeling and classical pedantry began to prevail; and at the same juncture our architecture began to exhibit a species of transformation, of which, John of Padua, and other adventurers, were the instruments. But in spite of these indications, we should be disposed to set down this era as being the climax of that progress in architecture and literature which began about the times of Chaucer and William of Wykeham, and ended with Shakspeare, and the architecture of Henry the Seventh; and which has never yet been surpassed in this country. There is no part of our literature, or of our architecture, that is so national; and although it may display occasional vices which do not attach to a later period, there is none distinguished by so many virtues.

These analogies are not, we think, accidental, and a further inquiry will show that they extend down even to our own times. Inigo Jones and others introduced the Italian style into England, about the time of Ben Jonson. Dryden, and his successors remoulded our poetry on the classic model. The innovations thus introduced reached their greatest altitude in the hands of Pope and Sir Christopher Wren, from which time they have been gradually declining. The declension, however, has been extremely slow; and the transition to a new state is probably not as yet much more than half completed. The engaging fancy of Collins, and sublime genius of Gray, failed to achieve any great change in poetical composition, simply because the fulness of time had not yet come, and the exertions of Vanburgh and Sir W. Chambers, to adapt the predominating architectural forms more completely to our wants and uses, have almost entirely failed from the self-same cause. The public mind had sunk into a kind of lethargy, and was satisfied with that negative species of excellence which consists in the absence of all offensive characteristics. The French literature, which had been slower in its growth than that of other European nations, reached its maturity at this period, and consequently acquired almost faultless elegance at the expense of originality and strength. The desire to make it classical made it timid and imitative, and deprived it of the charm of nature. The commotion, however, which preceded the French revolution, put an end to this state of things. An avidity for strong emotion succeeded to the desire to avoid disgust, and the effect of the agitation of men's minds upon literature became more visible as the time of the explosion approached more nearly. Rousseau and Goethe by their works of fiction began to exercise a powerful influence over the public imagination, and in our own country the poignant lines of Pope and his followers began to lose their charms, and gave way before the animating stanzas of Scott, and the soul-stirring poetry of Byron. In architecture, the change corresponding to this change in literature has not yet taken place. It is still in a state of elegant imbecility; but a revolution is, we believe, at hand, and is foreshadowed by our poetical mutations, to which our architectural proficiency appears to be inseparably bound, though the length of the tie may occasionally vary. Both, in fact, are merely modes of one elementary principle, and this principle is itself affected by almost every conceivable modification in the state of the community. Neither the poetry nor the architecture of the times of the Heptarchy could become popular at the present day, though there are manifestly some qualities both in the buildings and poetry which delighted our ancestors, which must continue to please in all ages. The contemporaneous condition of the public feeling will exercise a powerful influence on particular modes, and even independently of such accidents, revolutions in taste will sometimes occur from the mere influence of satiety. Men in course of time become tired even of excellence, and *will* have a new fashion, even though it should be a worse.

It is needless to dwell, however, on such speculations, for none of our readers, we believe, will be inclined to dispute that an affection for novelty and strong emotion does not constitute one of the ruling features of the present age. This perpetual aspiration for something new has been manifested in architecture, though not by any means to the same extent as in those arts which deal in less costly productions. Indeed, the expense and durability of architectural works, make the art in the strictest sense of the word a conservative one; every one is disinclined to introduce innovations which may fail to earn public approbation, and which, if unsuccessful, cannot be remedied without a great expenditure. In the smaller class of works this objection does not equally apply, and in such works new styles of decoration should, we think, be introduced as frequently as possible by way of experiment. It is thus only that architecture can be made a progressive art, and an art which is not progressive must necessarily retrograde. In all attempts at improvement, failure must of course from time to time occur, but even failure will minister to a further progress—often more effectually than uniform success. We believe that at no time in our history would architectural innovation be more favourably received than at present; the poets have already prepared the way, and the public mind was never more intent on that onward progress which flows from the worship of perfection.

Art. IV.—THE IRON TRADE.

1. *Suggestions to Iron Masters on increasing the demand for Iron.* By F. P. Mackelcan, Civil Engineer. London: Simpkin, Marshall and Co. 1843.
2. *The Iron Trade, with Remarks pointing out the true Cause and Cure for its existing State of Depression.* By John Hall, Iron Merchant. London: Simpkin, Marshall and Co. 1843.

The first of these pamphlets is an exceedingly clever one,—a little impracticable, perhaps, in some of its recommendations, but upon the whole both ingenious and judicious: it has also the subordinate merit of being uncommonly well written. Mr. Hall's pamphlet is of a much inferior quality:—it aspires to answer Mr. Mackelcan, to which it is totally unequal, and the heavy arguments it brings forward only show that Mr. Hall does not understand the nature of Mr. Mackelcan's suggestions. A summary of these suggestions we shall here lay before our readers.

The present great depression in the price of iron is due to over production, the demand not being equal to the supply. There are two ways in which this derangement of equilibrium may be adjusted, the one by increasing the demand, and the other by diminishing the production. It is needless to say that of these two alternatives the former is the preferable; and the question thence arises, in what way an increased demand for iron may be brought about. Now it is sufficiently obvious that the iron trade will fluctuate with the vicissitudes of other branches of manufacture, and that whatever causes operate beneficially upon the general trade of the country will correspondingly ameliorate this particular department. All this is so obvious that Mr. Mackelcan does not stop to point it out, but proceeds at once to inquire in what way the demand for iron may be increased while the general condition of the country remains the same. We here introduce Mr. Mackelcan to our readers.

> " The demand may be increased in two ways.
>
> " 1st. By making known to the world *all* the uses of iron which exist.
>
> " 2nd. By showing to what *new uses* iron may be applied with advantage.
>
> " How this is to be done I will presently endeavour to show; but must premise, that it will be best understood if the public will exercise patience, and judge of the whole plan when fairly laid before them.
>
> " I propose, then, that the Iron Masters should unite into a Society, or Association, and that they should each subscribe as members of the *Iron Masters' Institution.* This institution, like all others, would require a building, which might be purchased or rented by the members. It should be in some central position in the iron country, and convenient for the meetings which would be held in it, as it would, of course, become the head-quarters of the Association. It should contain a hall for meetings, a library, a model-room, a gallery for the exhibition of drawings, a secretary's office, and a few other rooms."

Mr. Mackelcan proceeds to illustrate his first position as follows :

> " Iron is used for many purposes in England, for which other metals and substances are used on the Continent; and the same may be said of different parts of England itself; the same also of different towns in the same part of the country, and of different branches of trade in the same towns. We may take an example from agriculture, as that is prevalent in all countries. Ploughshares are of wood in some parts of Europe, and so also are harrow teeth; in England they are both invariably of iron. In some parts of England, however, the framework of these implements is of iron, and in others of wood; these two varieties may be found, not only in the same neighbourhood, but on the same farm, and in the same field. The same may be said of nails, which are of wood in the forest portions of Europe and America, both for building and for other purposes, such as shoemaking; while, here, they are of iron. Railings, gates, and hurdles, are of iron as well as of wood, in England; but in other countries metal is seldom thus used."

One of the main causes of the limited use of iron, this gentleman attributes to the ignorance which prevails respecting its advantages and modes of application. He contends that the use of iron would be greatly extended by the removal of these discouragements; and this end, the proposed institution, by the circulation of knowledge on those subjects, and by offering premiums for the best essays pointing out the numerous purposes for which iron is adapted, would, he maintains, go far to accomplish. Mr. Hall, on the other hand, ridicules the idea of such an establishment. It is not the business of iron makers, he says, to go into scientific questions of construction, or to intermeddle in details which belong to the civil engineer, but merely to see that the raw material, with which they alone have to do, is of good quality. This objection, however, it is clear in no wise affects Mr. Mackelcan's position. It is not his doctrine that iron makers should become civil engineers, but that they should collect such information relative to the uses and advantages of iron in the arts, for the benefit of engineers and others, as may conduce to its more extended introduction. It may be very true that civil engineers are perfectly qualified to judge of the circumstances in which iron should he applied, but the civil engineer has no interest in promoting its application, and in any case of doubt or difficulty, or even of indifference, he will probably give the preference to more orthodox materials. In the application of iron however to engineering purposes, the iron makers have an interest sufficiently great to repay them for the labour and trouble spent in inducing its employment—a trouble which the civil engineer, from the want of an adequate inducement, will not incur.

Among the new applications of iron which Mr. Mackelcan suggests are columns, according to a new architectural order, suitahle for cast iron—window sashes, mantelpieces, and staircases, tombs and monuments, shot towers and light-houses, tunnels beneath rivers, formed of great cast iron pipes joined in lengths, canal locks formed of cast iron plates with concrete behind, abutments for arches, and piers for suspension bridges. For furniture, too, he thinks iron might be more extensively used; its value for bedsteads is already recognised, and for chairs and tables in warm climates ; it certainly seems entitled to a preference over wood, on account of its antipathy to vermin. Upon all these several subjects, premiums Mr. Mackelcan thinks should be offered by the Iron-makers' Institution for the best essays, so that both the public attention might be drawn to the suhject, and a mass of important information accumulated, which might contribute to dissipate the prejudices with which iron is now regarded, or dispel the difficulties which lie in the way of its application. Such then, is Mr. Mackelcan's remedy for the disorders with which the iron trade is afflicted. Some of his views are, in our judgment, a little too glittering and enthusiastic; yet, there is, we are persuaded, much truth in them, and upon the whole we are disposed to look upon his project most favourably. It would not, we think, have the effect of giving that precedence to the iron trade which Mr. Mackelcan supposes, and if it did, we are not sure that we could extend our approbation towards it, inasmuch, as in that case it would injure other trades in the same proportion in which it benefited the trade in iron. But we do not anticipate such a result from the estahlishment of the Iron-makers' Institution, for so soon as a deranging effect became perceptible, every trade which sustained injury would start a rival institution, to promote its interests by similar expedients, and the former balance would thus be restored. Out of such contests, however, much advantage to the operative arts would, we are confident, arise, and we should not be in the least sorry to see them at once begun.

ART. V.—THE FACTORIES OF LONDON.

Days at the Factories, or the Manufacturing Industry of Great Britain described. Series 1.—London. By GEORGE DODD. London : Knight and Co., 1843.

THIS will be a popular book, though that result will, we fear, be rather due to the attractions of the suhject than to any great ability on the part of Mr. Dodd, or any peculiar excellence in the way in which the work is got up. We have descriptions of above twenty different kinds of factories situated in London, and of the manipulations carried on in them ; and although these descriptions will, we doubt not, be interesting to the juveniles, to persons of a maturer judgment, they will, we think, appear extremely finical and superficial, and will fail to earn any solid reputation. We think Mr. Dodd's statements are in the main correct, but many of them might have been left out with great advantage to the remainder. He makes a great deal too many claims too upon the wonder and admiration of his readers, and is occasionally intolerably long winded respecting some of the simplest and most familiar processes. Some of the mechanisms, moreover, he has set up as standards, are imperfect and out of date ; and the high terms in which these antiquities are spoken of as if they were the perfection of modern practice carries the conviction to our mind that Mr. Dodd is to a great extent ignorant of the subjects he undertakes to illustrate. This book is consequently of no authority with practical persons, and of only a very limited utility to any one else, except so far as it may serve to rouse the minds of young persons to a less superficial inquiry. It is well adapted, we think, to the nursery, and perhaps to the school ; but not at all to the college, and is by no means the book relative to the various branches of our useful arts, that we have long stood in need of. Mr. Holtzapffel's book, on mechanical manipulation, is one important step towards the achievement of this great desideratum, but we question whether the desired work can ever be the production of a single person, however great his proficiency.

Although London does not come under the denomination of a manufacturing place, yet there are certain branches of manufacture which appear to have taken root there ; and which have resisted all attempts at transplantation. This is, no doubt, in some cases owing to the necessity for frequent communication between the producer, and the parties for whom things are produced—as in the case of printing for example, which could not without great inconvenience be carried on at a distance from the publisher and author. But in other cases London maintains a preference as a seat of manufacture, though no such inconvenience would arise from a provincial location ; and the secret of the predilection seems altogether to lie in the magic of the name. Certain articles if they he only London made, will attain a higher estimation, and realize a larger price than if made in the country ; and this gives London an advantage for those manufactures, which enables it to compete with the lower wages of the provinces. In almost all articles of wearing apparel, in musical instruments, and even in ships and steam-engines, London has attained a reputation which stands it in the most beneficial stead, and without which the provinces would be far more formidable competitors than they have yet been found to be. On the continent in particular, the name of London carries the idea of excellence, and by a natural, though absurd association, the dignity or insignificance of the place becomes exponential of the qualities of its productions.

The most remarkable factories of London are, perhaps, its breweries ; and there is none in which the influence of a name has been made more conspicuously manifested. At one time it was supposed that the composition known as London porter could be produced nowhere but in London, and its peculiar virtues were attributed to the use of the Thames water. This heresy is now exploded, and indeed it is very well known that the larger proportion of the London breweries are supplied with water by wells, and do not make use of the Thames water at all. In spite, however, of this revelation, the London porter retains its celebrity ; and although a compound equally good might no doubt be made in any other part of England, it probably would be unmarketable, especially in foreign countries, so long as it was without the London name. In the article of coaches, again, a great prejudice exists in favour of the London manufacture ; cutlery made in Sheffield is stamped with the word ' London ' to give it currency, and in many places none other than London hats are saleable. These prejudices are, however, wearing away by degrees, and in another century or two will probably be nearly obliterated. In former times they included a still wider range of items than at present ; when Mr. Boulton hegan to make buckles, he had to send them to the continent, and then reimport them before he could sell any.—We are, however, losing sight of Mr. Dodd.

The first establishment of which a description is given is, the brewery of Messrs. Barclay, Perkins, and Co., near the end of Southwark bridge. The operations here carried on, are so closely similar to those we described in a former number, when speaking of Truman, Hanbury and Co.'s brewery, that it would he superfluous to elucidate them more particularly. This brewery formerly belonged to Mr. Thrale. At his death it was sold to Messrs. Barclay and Perkins, for the sum of one hundred and thirty-five thousand pounds. Dr. Johnson was one of Mr. Thrale's executors, and appears to have driven a hard bargain at the sale.

The next place Mr. Dodd describes is, the distillery of Messrs. Smith and Co., between Vauxhall-bridge and Chelsea. Most of the processes of distilling are so nearly correspondent with those of brewing, that our notice of this establishment may be very brief. The grain used does not consist of pure malt, as in the case of making beer; but of a mixture of wheat, barley, rye, and oats; with about a tenth part of malt. These are all ground up together, and mashed as in the operation of brewing, from whence a 'wort' is obtained; and this wort after undergoing the process of fermentation becomes changed into a liquid, consisting chiefly of water and alcohol, and from which by distillation the spirit is obtained. The spirit after leaving the hands of the distiller passes into those of the rectifier, by whom it is re-distilled for the purpose of removing any disagreeable flavour. By the rectifier also it is compounded into the forms of gin, British brandy and cordials, or purified into that of spirits of wine. The ultimate quality of the spirit, perhaps, mainly depends on the skill and care with which the rectification has been conducted. The rectifier can remove almost any flavour, and superadd almost any other. The flavour of musty corn, however, has hitherto we believe resisted the rectifier's skill, and if the spirit be infected with this taint it is incurably bad, and useless for any other than chemical purposes.

We must now accompany Mr. Dodd to Messrs. Beaufoy and Co's. vinegar works. Here the preliminary processes are almost identical again with those of brewing. Malt is the material out of which the vinegar is made. The malt is mashed, and a wort obtained as in ale or porter brewing, and this wort is fermented in the common way. In this state, however, it is not called beer, but *gyle*. It has undergone the vinous fermentation, and now it only requires to undergo the acetous fermentation to become vinegar. This fermentation is superinduced either by exposing the *gyle* in casks for a long period to the sun and air, or for a shorter period to the high temperature of an artificially heated room. After the process of a rectification is completed, the vinegar is fined or rendered 'bright,' as the technical phrase is, by being filtered a number of times, through a mass of raisin skins and stalks, which have been found more effectual than any other substance for this purpose. To keep up a supply of this filtering material, many vinegar works formed establishments for making raisin wine, and the manufacture flourished well until the legislature passed a law making it penal for the same persons to sell British and foreign wines. This law gave the raisin wine manufacture a shock from which it has never recovered, and it has now dwindled into such insignificance that the duty formerly levied has been abolished, as not being worth the trouble of collecting.

It is time, however, that we should give our readers a specimen of Mr. Dodd's talent at description. They may take the following account of a sugar refinery, which forms the subject of the fifth day's visitation, at which point we have now arrived.

"If it were allowable to personify the East and West ends of London, we might consider them as strangers who have occasionally heard of each other's existence, but who, from the wide interval between them, have had little mutual acquaintance. The dweller at the 'Court-end' of the town may, perhaps, have heard of 'Aldgate Pump,' as a spot remotely east, beyond the regions of the Bank, the Exchange, and the Mansion-house; and may, without the aid of a map, be in some doubt as to what exists still farther eastward. But he who would form an adequate idea of the metropolis in all its length and breadth, must be prepared to hear of a vast population,—a very world of human beings,—beyond the point to which we allude.

"It is to this eastern district, and to one particular part of it, that we beg to direct the reader's attention in the present article. Most persons have heard of the occupation of a sugar-refiner,—often, though erroneously, termed sugar-baker,—that is, one who prepares the white conical lumps or loaves of crystallized sugar familiarly known as 'loaf-sugar.' Now, the buildings or 'refineries' in which this operation is carried on are not only situated in the east of London, but most of them are congregated within a circle of half a mile radius immediately eastward of Aldgate. Those who would seek for a reason why so many members of one trade or manufacture settle near each other, may be reminded that Oriental bazaars exemplify this custom to a remarkable extent, and that the object is principally to afford facilities to purchasers. At Constantinople, Bagdad, and other Eastern cities, each of the principal trades has its own bazaar,—one for jewellery, one for silks, one for spices, and so forth; and purchasers know at once what part of the city to visit when any commodity is required. In London, the admixure of trades and professions in most trading streets is now such, that the bazaar method is little observable (for the motley 'bazaars,' commonly so called, scarcely come within the proper meaning of the term); but still, whoever notices the assemblage of sugar-refiners in the neighbourhood of Goodman's-fields, the woolcombers in Bermondsey-street, the coach-makers in and near Long Acre, the watch-makers in Clerkenwell, the statuaries in the Paddington-road, and many similar instances, will not fail to observe indications of this custom, and to attribute it to some sufficient motive. Proximity to docks and warehouses furnishes a principal motive in the first-mentioned instance. Whether the sugar-refineries have, ever since their introduction into England, been located in this district is not exactly known, but such would seem to be probable. Stow, in the following remark, does not make mention of any particular part of London:—'About the year 1544 refining of sugar was first used in England. Then there were but two sugar-houses; and their profit was but little, by reason there were so many sugar-bakers in Antwerp, and sugar came thence better and cheaper than it could be afforded at London. And for the space of twenty years together these two sugar-houses served the whole realm, both to the commendation and profit of them that undertook the same.'"

We are not so unreasonable as to ask our readers to toil through the succeeding pages of this laborious trifling, wherein Mr. Dodd proceeds to inform us with much solemnity that a considerable quantity of sugar comes from the West Indies, and that brown sugar varies in quality, there being 'eightpenny moist,' as well as 'sevenpenny.' We cannot, however, resist giving the following *morceau*. The dignity and splendour of the picture, cannot fail to strike the most cursory observer.

"Here was a hogshead of sugar, suspended from the crane, and just on the point of being drawn into the warehouse; there was another hogshead, deposited on a low iron carriage, and being wheeled farther inwards; near it was a third, being weighed,—a process requiring tackle of no slight kind, since the hogsheads, when filled, vary from 4 to 18 cwts. each; farther on was a man knocking out the head of a hogshead, and a party of others emptying the contents on a boarded floor; while other hogsheads, some empty and others full, were lying around in various directions."

The first step in sugar refining consists in dissolving the sugar in water. The solution is accomplished in a cistern called the blow up cistern into which steam is introduced for the purpose of heating the water, and promoting the melting of the sugar. A small quantity of lime water is then added, and the syrup is filtered by being passed through a number of strong cotton bags suspended from the bottom of a cistern. The syrup on leaving the filters is very transparent, but has a brownish hue. To deprive it of this tinge it is passed through a layer of powdered animal charcoal about three feet in thickness, and by this simple and single process it becomes almost as colourless as water. The next step is to concentrate the syrup, until it attains sufficient viscidity to chrystallize. This is done by boiling the syrup in close vessels by the agency of steam traversing an internal pipe, a vacuum being at the same time maintained in the evaporating vessels, by condensing the vapour as fast as it is formed, either by a jet of cold water let into a pipe into which the vapour passes, or by the application of cold water to this pipe externally. The advantage of the plan of evaporating *in vacuo*, consists in the avoidance of all danger of burning the sugar by a high heat,—the boiling point being much lower *in vacuo*, than under the ordinary atmospheric pressure, and the heat of steam being consequently sufficient *in vacuo* to accomplish the requisite evaporation. The heat of the evaporating pans is about 140, and when the requisite consistency has been attained, the liquid sugar is drawn off into open pans, where it is heated to about the temperature of 180°. By this operation, any chrystals formed in the evaporating pans are re-dissolved, and the sugar acquires an uniformity, which gives it a finer and firmer texture when cold. From these open pans which are termed heaters, the liquid sugar is ladled into scoops with which the conical moulds are filled. These moulds have small holes at their apices, out of which a certain quantity of syrup exudes; and when no more will come out, a mixture of loaf sugar and water is laid upon the upper surface of the inverted sugar loaf, the moisture from which permeates the mass, and carries away any unchrystallizable portions which may still remain.

We must endeavour, however, to find a more favourable specimen or two of Mr. Dodd's authorship than we have yet hit upon. The following on the snuff manufacture occurs to us as being very passable.

"Snuff is made from stalks alone, from leaf alone, or from leaf mixed with stalk,—circumstances which render the whole of the imported leaf valuable. In every case a greater amount of care is required in the preparation of snuff than of tobacco. The various qualities of snuff are due to a great variety of circumstances, principally under the controul of the manufacturer. The purest kind, known by the name of 'Scotch,' is either made entirely of stalks, or of stalks mixed with a small portion of leaf; and in either case there is very little 'liquoring' applied to the tobacco, as that would darken the colour of the snuff. There are many kinds of snuff called 'high-dried,' such as 'Welsh' and 'Lundyfoot' (the latter being named after a celebrated maker.) These owe their qualities chiefly to the circumstance that they are dried so much as to acquire a slight flavour of scorching.

"The snuffs called 'rappee,' of which there are two kinds, 'brown' and 'black,' are made chiefly from leaf, mixed with the 'smalls,' or broken fibres of tobacco, that are too small to be smoked conveniently in a pipe. The dark colour is principally produced by wetting the powdered tobacco in a bin or box, and allowing it to remain for a considerable time, turned occasionally with a shovel; during which time it undergoes a slight degree of fermentation, whereby the colour is darkened.

"The original quality of the leaf is as much attended to as the manufacturing processes. 'Scotch snuff' is made principally from the stalks of light dry leaves; whereas 'rappee' and the darker snuffs are made from the darker and ranker leaves. A process of *scenting*, too, has great influence on the flavour of the snuff, since the manufacturer can introduce any kind of scent which he thinks may please his customers. Thus, 'Prince's mixture,' among the low-priced snuffs, and the interminable varieties of 'fancy snuffs,' owe no small part of their flavour to the kinds of scent introduced. Other kinds, however, such as 'high-dried,' 'Welsh,' 'Lundyfoot,' &c., are chiefly dependent on the peculiar circumstances under which they are dried."

The next paragraph is not so good, it degenerates into prolixity, which is Mr. Dodd's besetting vice; yet is upon the whole more tolerable than most parts of the volume.

"It is a curious circumstance, and one little suspected by those who are in the habit of using snuff, that almost the whole of that article which is sold in the metropolis, either wholesale or retail, is ground in or near the town of Mitcham, in Surrey, owing to the excellent water-power afforded by the river Wandle, in flowing through the town. Many manufactories on the Wandle derive their mechanical power from water-wheels, which were almost invaluable before the use of steam became prevalent. The advantage of employing a particular class of persons for grinding snuffs, instead of each manufacturer grinding his own, is easily understood. Few manufacturers dispose of enough snuff to keep a grinding-mill constantly employed; and under such circumstances it is generally cheaper to obtain the aid of another person whose premises and arrangements are devoted wholly to that occupation. Such is the case with regard to the snuff-mills on the Wandle. There are several of these establishments to which the London manufacturers send their snuff in a certain stage of preparation.

"The mills are provided with two different kinds of grinding-machines. In one of them a pair of cylindrical stones, several feet in diameter and a foot or more in thickness, are set up on edge on a slab or bed beneath, and have then a twofold motion given to them, resembling that of the wheel of a carriage which is going round in a small circle. By means of a horizontal axis passing through the centre of the stones, the stones wheel along the surface of the bed; and by giving to the axis itself a motion round another but verticial axis, the stones are carried round in a small circle. The snuff to be ground is laid on the bed or support, and the broad edge of the heavy stone passes repeatedly over it, by which the particles are reduced to powder.

"In the other form of grinding-mill, the snuff is put into a kind of cell or mortar, in which it is ground by a pestle moved in a singular manner. The pestle is connected with a set of jointed arms or levers, so adjusted one to another as to give to the pestle a motion best calculated to effect the grinding of the snuff. Every establishment for grinding snuff contains a considerable number of both these machines; since some kinds of snuff are best ground by the one, and others by the other.

"Beyond the grinding, and a preparatory drying, nothing is done to the snuff at the snuff-mills. The proprietor brings it to a certain stage of prepartion before it is sent to the mill, and in most cases passes it through some finishing operations after it is brought from the mill. The high-dried snuffs, such as Lundyfoot, Welsh, Scotch, &c., are sometimes made from stalks, which, before grinding, are cut into fine shreds; but very often the entire stalk is dried so intensely that it may easily be ground to powder without the preparatory shredding. In such case the lightest and finest stalks are presented.

"Many of the London manufacturers have small mills on their own establishments, for grinding small quantities of snuff, or for passing through any particular process the various kinds of fancy snuffs; but we are not aware that there is a single establishment in London where the main bulk of the snuff is ground."

Let us now turn to Messrs. Christy and Co.'s hat manufactory, and take a view of the several processes carried on there.

A beaver hat consists of two parts, the body and the nap. The first is made of wool and coarse fur felted together—the latter of the fur of the beaver.

The fur of the beaver consists of two kinds of hairs—the one long and coarse, and the other soft, fine, and short. It is the latter variety alone that is useful in hat making, and it has, therefore, to be separated from the useless kind. This is done by means of a blowing machine, which removes the finer hairs to a much greater distance than the coarser ones. The fur is cut from the skins by a species of knife worked by machinery: the combination resembles a guillotine.

The body of a good beaver hat is made of a mixture of wool and of the fur of hare and rabbit skins, to which a small proportion of lama wool is usually added. About 2½oz. of this mixture is weighed out for every hat; and, by the operation of 'bowing,' the fibres are disentangled, and the material spread out into a sheet of uniform thickness. This sheet of wool and fur is pressed gently by a wicker frame, to give it a slight cohesion. A piece of oiled leather, called a 'hardening skin,' is then laid upon it, and pressed down firmly with the hand, by which means it is formed into a species of loose felt. Each piece of this felt is called a 'batt,' and each batt is formed into an embryo hat by placing a triangular piece of paper upon it, and turning the felt over the edges until it joins above, forming a cone open at the bottom. The felting is completed by working this rude cap in hot water slightly acidulated with sulphuric acid, in which operation the cap contracts to about half its original dimensions. In this operation the workman brings the cone to a uniformity of thickness, and takes care to work down the materials so as to afford adequate substance for the future brim.

The felting being completed, the next operation is to make the hat waterproof. This is done by varnishing the felt cone, after it has been thoroughly dried, with a solution of shell-lac, Indian-rubber, and various gum-resins. It is then stoved, to drive off the superfluous spirit of the solution, and scoured with a weak alkali, to detach the water-proofing material from the surface, so as to enable the beaver fur to adhere. A cone of this beaver fur (which has also the felting property) formed in precisely the same way as the first cone, but of a far thinner substance, is then slipped over the felt cone, and the twō are united by friction and pressure, which cause their fibres to interlace and adhere. It is the property, indeed, of the fibres of the beaver fur to penetrate felt or cloth by continued working, on the same principle that an ear of barley will ascend the sleeve by keeping the arm in motion. Each beaver fibre is furnished with minute filaments corresponding to the beard of the barley; and if a few beaver fibres be put upon a piece of cloth, and worked backwards and forwards, they will penetrate the cloth, and appear on the other side. In hat making, only so much working is employed as will enable the beaver fibres to penetrate the felt. so far that they will not come out when the hat is brushed. A further working would occasion a useless expenditure of fur, by burying much of it in the substance of the felt.

The beaver fur having been applied, the hat is again subjected to the action of hot water in 'the kettle,' which both achieves the fixing of the beaver by the combined action of heat, moisture, friction, and pressure; and, by softening the gum resins, enables the hat to be brought into shape. A shape approaching that of a hat having been given to the felted cone by the workman, it is next blocked into the hat form by means of a mould, and then dyed with a decoction of logwood, in which certain metallic salts have been dissolved. The hats are dyed upon the blocks—the blocks being fixed upon a great frame, so made that it can be lowered by a crane into a dye-cauldron. The next operation is the finishing. The hat is held over a jet of steam, by which it is softened, and the nap raised and rendered pliable. The nap is then laid in the right direction by brushes; and the hat, by means of moulds and instruments, is brought to the required shape. The lining is put in by women, and the finishing touch is given by an artist called the 'shaper,' who, by some curve, or compression, or expansion of the brim, superadds a grace, and gives the *ton*. The shaper is, in fact, the milliner of the dandies, and that generation alone can adequately appreciate his importance. Such, then, are some of the operations carried on in the factory of the Messrs. Christy.

The eighth day brings us to the leather manufactory of Messrs. Bevington. There are four principal kinds of leather known in the arts, and they are prepared by the agency of very different substances. The first kind of leather is that used for boots and shoes, harness, and other things of a similar nature. This leather is tanned with oak bark. The next is the morocco leather used for covering chairs, &c; the roan, used for book-binding, and slippers; and the skiver, used for hat-linings, and other similar purposes. This variety of leather is tanned by means of sumach. The third kind is prepared by means of alum, and consists of the kid used for gloves, the leather used for apothecaries' plasters, &c.; and the last is chamois leather, which is dressed in oil.

The first step in leather-making is to detach the hair or wool from the skins; and there are two ways in which this may be effected. The first consists in immerging the skins in a mixture of lime and water; and the second, in placing them in a close and damp chamber, where a fermentation in the skins may be promoted that will loosen the hair or wool. The first is the plan almost universally adopted in the case of skins covered with hair; and the second, in other cases, the wool being susceptible of injury from the action of the lime, and being valuable, whereas the hair detached by the lime is nearly worthless for every purpose. The operation of detaching the wool from skins to be converted into leather is not usually accomplished by the tanner, but by a class of persons known as 'fellmongers,' who furnish the stripped skins, or 'pelts,' as they are technically called, to the tanners. Antecedently to the removal of the hair, the skin undergoes the process of 'fleshing,' which consists in the removal of any bits of fat or flesh that may attach to the skin. The hair is then removed, and the naked skin is steeped in a liquid, consisting, sometimes, of a weak mixture of sulphuric acid and water, or some other acidulated liquid, and at other times of an alkaline solution, which causes the skin to soften and swell, and opens its pores for the reception of the tan. In the case of oak-bark tanning, the hides are now put into the tan-pit, in which they require to remain from six to eighteen months—depending on the thickness of the leather. When sufficiently tanned, the leather is hung up in lofts to dry, and is then passed into the hands of the currier, by whom it is brought to an equal thickness by cutting away the irregular and superfluous parts, and then dressed with oil and lampblack, if intended for shoe-leather.

The leather prepared by sumach requires the same preliminary processes as in the case of leather prepared by oak-bark; but the tanning process, or the act of converting the skin into leather, is very different. There are no tan-pits used in sumach tanning, but every skin is sewn up into a bag, which is filled with a mixture of sumach and water. These filled skins are then thrown into a large and shallow tub containing a mixture of sumach and hot water, and are stirred round occasionally for the space of three hours. They are then taken out, and piled upon top of one another until their own pressure forces the liquid through the pores. The same round of operations is again gone through, at the end of which the skins are converted into leather. The skins are then washed, stretched on a board, and scraped and rubbed as smooth as may be. They are next dried, and finally receive the colour it is intended they should have. The morocco leather produced by this process is, for the most part, dyed of some lively colour; and, to economise the dye stuff, which is usually expensive, the skins are put back to back, so that their right sides alone may receive the dye. The corrugated appearance morocco leather presents is produced artificially, by being rubbed with a grooved ball of box or some other hard wood, and which not only leaves marks on the surface, but makes the leather more pliable and more tough. The true morocco is made of goat-skins exclusively; but a fictitious kind is extensively made out of sheep-skins. The process is almost identical in the two cases.—We are monopolizing the talk, however, and must here hold for a little, to let Mr. Dodd have a spell.

"The kind of sheep-skin leather called 'skiver,' used for common bookbinding, hat-linings, pocket-books, work-box covers, and other cheap purposes, deserves notice for a process the most remarkable, in a mechanical point of view, which the Neckinger establishment presents; we mean the 'splitting' of a skin into two thinner skins. Thin as a sheep-skin is, and supple when wetted, it might be thought that the operation of splitting or slicing it into halves, without cutting holes in either, would be an impossible task; yet this is effected with the utmost accuracy. We have seen, at a large tannery in Bermondsey, a machine for splitting hides; but the small thickness of a sheep-skin requires peculiar arrangements for effecting a similar bisection. The object aimed at in this operation is twofold, viz., to obtain a thin kind of leather for some purposes for which a sheep-skin in the natural state would be too thick, and to obtain a quality of leather which would be sold at a lower price than that made from a whole skin. The principle of the machine is this:—Two rollers, ranged horizontally in a frame, are made to rotate in opposite directions, the vacancy between them being only just sufficient to admit a soft wetted sheep-skin or pelt. The rotation of the rollers causes the skins to be drawn slowly between them; but it cannot do so without encountering the blade of a very sharp knife, which has a reciprocating horizontal motion, in such a position as to cut the skin into two thicknesses as it passes the knife, one-half passing over, and the other under the blade. A most ingenious contrivance is adopted for yielding to any inequalities which may occur in the skin. One of the rollers is made in several pieces, so adjusted that in passing over any thickened portions of the skin the common aperture between the rollers is widened at that part. It is one of the consequences of the construction of the machine, that one of the semi-thicknesses or sections of the skin must be equable and level in every part, while any inequalities which might have existed in the original skin will be thrown into the other section."

The following, relative to leather prepared with alum, is well said. It is selected, however, from much that might with advantage have been left out.

"The technical name of 'tawing' is frequently applied to the general routine of operations whereby alumed leather is produced. This variety of leather is in many cases left white or undyed, and has a peculiar softness when finished. The skins which undergo the process of 'tawing' are those of the kid, the sheep, and the lamb; the first-named of which yield the well-known 'kid leather' of which gloves and ladies' shoes are made; while the white leather made from sheep-skin is used for lining shoes and other inferior purposes. The cheap kid gloves which are displayed in the shop-window of the hosier are generally made from lamb-skin, and may be considered as an 'imitation' kid.

"Instead of being sewn up into bags filled with sumach liquor, and immersed in a tub of hot water, the skins are put into a kind of barrel called a 'roundabout:' this barrel has a door or opening in one part of its curved surface, through which the skins are placed; and when the water and ingredients are added, the door is closed, and the barrel made to rotate rapidly. The effect of the rotation is to cause the impregnated liquor to act intimately on every part of the skin. The substances placed in the barrel to act on this skin are, for the commoner kinds of leather, alum and salt; and for the better kinds, alum, salt, flour, and yolk of eggs: these latter ingredients are for the most part absorbed into the substance of the finer kid leathers, and seem to have the effect of imparting that beautiful softness and plumpness which such leather presents. About twelve pounds of alum, and a little more of common salt, are sufficient for about two hundred skins. Sometimes the skins are not put into the 'roundabout,' but are merely steeped in the solution in an open tub: whether the one or the other plan be adopted, however, a period of five minutes is sufficient to produce the effect. In that part of the 'tawing' process wherein eggs are employed, the eggs are broken, in the proportion of one to each skin, and the yolks only are mixed with water and a little meal in a tub: the skins are then introduced, and are trampled by the naked feet of a man until the egg has been thoroughly imbibed. The eggs employed for this process are imported from France: sixty or seventy thousand are purchased for the Neckinger factory every spring, and are preserved in lime-water till wanted; a mode by which they may be kept perfectly sweet for two years."

Chamois leather is prepared chiefly from deer and sheep-skins. The skins undergo the same preliminary processes as the skins which are tanned; but after their immersion in the liquid for opening the pores, they are dried thoroughly, and then impregnated with oil. When in the dry state, the smooth surface of the skin is generally removed either by a knife or by means of pumice-stone. The skins are then put into fulling stocks: cod-oil is poured upon them, and the oil is driven into the skins by continued beating. The skins, during this operation, are taken out eight or nine times, and hung in the air to dry, and more oil is added each time. They are then thrown together into tubs, where they undergo a slight fermentation, which appears conducive to the more effectual penetration of the oil. They are finally washed in an alkaline solution, by which all superfluous oil is removed; and when dried, are ready for use.

This concludes the account of leather making; and here, for the present, we must take leave of Mr. Dodd, but will probably accompany him to the remainder of the factories in our next Number.

Art. VI.—OUR CLUB. No. V.

Away the drivel of each fool,
That science only can be dress'd
In Quaker garb, by line and rule,
Because by fancy *he's* unbless'd.

Ourselves.

Scene—*The Club-room.*

Sederunt—Sir Jonah, Gray, Montgomery, *and* Scalpel.

Gray. Aye, an' that 's what ye call the Bude licht: feth, its a gran invention; but wadna the same quantity o' common gas answer the same purpose?

Sir Jonah. Dr. Ure says not; he says there is not so much blue in the flame.

Scalpel. A fine reason, truly; the quantity of blue depends upon whether the flame is big or little.

Gray. Wee flames are a' blue thegither.

Sir Jonah. Yes, I fear the thing is a juggle; and for that very reason I am anxious to give the plan a fair trial; but I fear this great flame will consume too much of the air of our little snuggery.

Montgomery. The more the better for Mons. Budda. It may impart a trifle of its wit to his alarmingly witless godship.

Scalpel. Good—I think it would be a charity to send Mr. Burney a few bottles for his own private consumption.

Gray. Ha, ha, haw,—man, it wad be gran' diversion: the cretur wad be as fu' as the Baltic the first pech;—the lauchin' gas would be naethin' till't; no, nor even a mutchin frae the worm that never dies.

Enter Gardiner, *with a basket of papers.*

Sir Jonah. Here come the Rejected Addresses: which of them was it you wished to see?

Scalpel. The essay on heat. From the glance I had of it the other day, I think it might be admitted. This is it—I will give you a specimen or two of its quality.—(*Reads*)—"There are three varieties of heat recognized by philosophers; sensible heat, latent heat, and specific heat. The first is that heat which is susceptible of measurement by the thermometer, and which may be compared to the quality of altitude, the base remaining the same. The second is that heat which is not measurable by the thermometer, and which is analogous to superficies, the altitude remaining the same. Specific heat is merely a comparative term, expressive of the relative heat in different bodies at the same temperature; water being taken as the standard of comparison, the specific heat of which is represented by unity."

Montgomery. That is all very just.

Sir Jonah. It is, but something common-place.

Scalpel. Yes, I see it merely recapitulates things every body knows. I must take the subject of heat in hand myself on an early occasion.

Sir Jonah. Have you any new views to offer?

Scalpel. Not new to you, perhaps; but I have never yet seen the subject treated satisfactorily. Even our friend the doctor, though his treatise is, in many respects, an admirable one, falls into the common error of confounding latent with specific heat.

Sir Jonah. Yes, I have observed that inconsistency: all the *philosophi* have fallen into the same error.

Gray. Whatna error is't?

Scalpel. They confound, as I stated, latent heat with specific heat; or rather, perhaps, I should say, do not properly distinguish between them. If steam be compressed or expanded, an alteration is said to have been made in its latent heat; while, if air be compressed or expanded, an alteration is said to have been made in its specific heat. Yet, the vaporous or gaseous condition is one accidental merely to the temperature,—an element by which the latent or specific heat is wholly unaffected.

Montgomery. Heat is only said to become latent when there is a change of state.

Sir Jonah. It is said to become latent in steam during expansion: in other words, in comparing high with low pressure steam, it is said that the quantity of heat in the *same weight* of both is about the same, the temperature of the high pressure steam being greater, and in latent heat less.

Scalpel. Precisely so; but the fact is, that heat becomes latent in the expansion of all bodies; and the specific heat of different bodies, ascertained by experimentalists, without regard to the heat due to this expansion, is manifestly in every case a compound quantity. Take Dulong and Petit for example——

Gray. Whaur 's hit to be bocht?

Scalpel. Take their determinations of the specific heat of iron. Their mode of procedure was to heat the iron to a given temperature, and plunge it into water; and from the temperature given to the water the specific heat of the iron was deduced.

Gray. I've done the same mysel' in the smiddy mony a time—wi' the tangs in particular.

Scalpel. This plan would have given correct enough results if the iron had undergone no expansion in being heated, and no contraction in being again cooled; but, as it is, it must be obvious that the heat they deduced is partly specific and partly latent. They have, in consequence, been unable to reconcile their experiments with their most ingenious conjecture, that the specific heats of bodies are inversely as their atomic weights.

Sir Jonah. Your views on this subject are very original and very important. I perfectly concur in them, and have no doubt that if the quantity of heat due to the expansion of the iron could be ascertained and deducted from the whole amount, the result would be found to be in the exact inverse ratio of the atomic weight of the iron.

Gray. Yes, I think so tae. Sir, I agree wi' you. Ye see the—the—the—deevil tak the name o' the wechts!—what for no will na they use the tron anes?

Scalpel. The atomic weights.

Gray. Aye, that's them they hae in the doctors' shops is na 't? Weel the wecht o' the wechts will be affected by the heat o' the weather, for ye see a pund o' hot airn, is lichter than a pund o' cauld thing.

Sir Jonah. Nonsense.

Gray. Nonsense! Whaur 's the nonsense? If the hot aren binna the lichter, what the reason that a piece o' cauld aren will soom on the top o' melted aren? There 's a bane for ye to pike.

Scalpel. If the hot iron were the lighter, the cold iron would sink in the metal. A body will float only in a liquid which is heavier than itself.

Gray. Eh—hoo—heavier: Aye, aye, it should be heavier than itself, I see; but what 's the reason that the aren sooms? It shows the difference between the hot and the cauld.

Scalpel. The reason is that iron expands in the act of solidifying. Its specific gravity is consequently diminished. In other words, it becomes a lighter body.

Gray. Expands in the acc o' soleedifyin'! Man, is na 't by heat that aren expands? Ye wad mak it expand by cauld.

Scalpel. And so it does under certain conditions. The fact is indisputable, and the reason is obvious. The molecules of the iron in solidifying assume a crystalline arrangement, which leaves interstices among them, not filled up by anything. The volume of the mass is consequently increased, or, what is the same thing, its specific gravity is lessened. It becomes, in fact, a lighter body, and will consequently float on liquid iron.

Montgomery. Water in the act of freezing exhibits the same phenomenon. Solidified water or ice, as it is called, floats on liquid water, which shows that in the act of freezing the water must have expanded. The point of maximum density of water, is about 39°, while the freezing point is 32°; water expands therefore in being cooled from 39° to 32°.

Gray. Then hoo comes it that in makin' our patterns we aye alloo an eicht o' an inch to the foot for contraction? The casting, accordin' to your doctrine, ocht to be bigger than the pattern instead o' wee-er.

Scalpel. And so it *is* bigger at the temperature at which cast-iron solidifies by the amount of compression of the mould. It is not at that temperature, however, that the casting has to be used; and in being cooled down to the ordinary temperature of the atmosphere it sustains a contraction, which makes the allowance for shrinkage indispensable.

Gray. I see you hae studied the subject: I hae the shrinkages o' a' kinds o' aren markit doon in this wee buyck. I made a' the calculations mysel, an' I'm gaun to hae 't printed; for it 's no every body that kens hoo to work decimal fractions; but I can work them fine; aye, an' can extrack the roots——

Scalpel. Of the Rad. Glycerrizhae——

Gray. Eh? Is that ayont the rule o' three?

Scalpel. No: those roots are extracted by the rule of thumb.

Gray. I didna learn hit; though maybe it 's only anither name for practice. But, as I was sayin', when I was at the schule I was gran at the roots.

Scalpel. Is it possible? then you can, no doubt, solve this question—

How many geese, at four and nine,
Would quill an unfledg'd porcupine?

Gray. Na, na—you'll no catch me that wye: it depends on the size of the porcupine: I can see that, brawlies.

Scalpel. Yes, I forgot to state the size. Let me see—what size shall we take?

From nose to tail four feet about,
And four feet six from tail to snout.

Gray. I maun refleck for a minute.——Four feet by four feet six—four times four is twenty-four, an' six is thirty-two—an' the geese at four an' nine—— Ye're sure it 's a quasten o' roots? Thirty-two multiplied by forty-nine, is—— Oh, 't is no a quasten to be dune off han'. I maun hae the sclate to 't when I gang hame, for it 's a wee kittle.

Montgomery. Yes, yes: let us see what is in the letters.

Sir Jonah. This paper on surcharged steam is not a bad one—rather superficial, but very well written.

Scalpel. The style is very like that of John Scott Russell.

Gray. An' so is the han' write. When we were makin' the steam-carriages—

Montgomery. Is that the ones that blew up? The less said of them the better.

Sir Jonah. I do not think this article resembles very closely those on Steam and The Steam Engine in the 'Encyclopedia Britannica.'

Scalpel. They were not written by Russell.

Sir Jonah. They have been since published in separate volumes, with his name on the title-page: that, I think, is evidence sufficient that they are his.

Scalpel. But they are not his, notwithstanding.

Sir Jonah. You must be misinformed: it is impossible to suppose any man, with the least pretensions to honesty, putting or consenting to put his name to a work which was not of his own composition. It would be a fraud upon the public.

Scalpel. I have the authority of Adam Black for saying that not a line in the 'Encyclopedia' articles, or in the little volume subsequently published, was written by Russell. He undertook to write the articles; but it was impossible to get him to fulfil his engagement, and the work had to be done by some one else—he pretending, or permitting it to be pretended, that the productions were his.

Sir Jonah. A pretty exposé! But why was not the name of the real author given? It would have carried with it quite as much weight, however little that might be.

Gray. Aye the steam-carriages was a bad job. An' then there was fechtin' awa wi' canal-boats, an' a wheen ether things that a' turned oot ill. But the chiel 's a clever bit writer: but oh, but he 's pernacketty an' consatey.

Montgomery. Lardner told me that Russell assured him that he gave the designs for the Unicorn and the Eagle; and that it was all owing to his wave-lines that those vessels performed so well. I do not know what Mr. Steele, of Greenock, would say to such representations.

Sir Jonah. Mr. Steele would only laugh at them. He is rich enough in reputation to be able to spare Mr. Russell a little to gild his brass with.

Montgomery. Here 's a letter to us from the bottom of a coal-pit, where the prosperity of the 'Artizan' has just been drunk with three times three.

Gray. Preserve us a'! an' here 's a sermon—an actual sermon, that might be preached by Dr. Chammers.

Montgomery. A true bill. It is not badly written either. I must give you one or two of the rainbow touches.—(*Reads.*) "Consider again how few of those popular authors, whose works are in everybody's hands—whose dramatic talents have gilded the obscurest pages of our national history—the spell of whose magic descriptions may have conjured up by turns, almost to the eye of sense—at one time the shattered pinnacles that seem marshalled like grim sentinels to guard the passes of Benvenue; and at another, the gallant Firth, with islands floating on its bosom like emeralds chased in gold:—whose wand can evoke the spirits that shriek among the whirlpools, or summons a troop of plaided warriors from the brackenbush or the heather plume:—how few of those whose writings display such a profound acquaintance with the hidden springs of human conduct have deemed it worthy of their genius to patronize the cause of Christ, or have tried to recommend it by their eloquence and erudition."

Gray. There 's muckle truth in that; an' it 's maist as weel said as if I had said it mysel.

Montgomery (*continues*). "Look again to our modern literature; not merely to the ephemeral publications, ushered into the world one month, and forgotten before magazine-day comes round again; but look to that great bulwark of our national literature, destined to make the first half of the 19th century take its place for ever as the Augustan age of English literature;—consider the 'Edinburgh Review'—destined, perhaps, to constitute an epoch in the history of mind—and tell me, you who know it so well, did it ever furnish an article entitled 'The Pearl of Great Price?'"

Sir Jonah. Pooh! that 's nonsense. Every publication cannot be a religious one. It would just be as absurd to object that every man was not a parson.

Gray. The Bible winna tell us hoo to mak steam-engines or coffer-dams. Na, na—Solomon, wi' all his wisdom, kent naethin' o' slide-valves.

Montgomery. This letter is addressed to you.

Gray. To me mysel'? Wha can hit be frae? A steam-engine on the seal—(*Looking at the contents.*) Ha—ha—ha—

Scalpel. What 's the matter?

Gray. It dings 'Punch' oot an' oot. Ha—ha—Did I ever.

Scalpel. What! a design for a memorial in honour of the 'Artizan.' Really, it is very witty. That cylinder, boiler, and other pieces of machinery, are put into a most ludicrous combination.

Montgomery. Look at the faces on the balls of that governor laughing at you.

Sir Jonah. The main figure is 3′ 9¾″ off the perpendicular. A clever insinuation.

Gray. An' see at that chiel fleein' through the air on a bolt; an' aboon a', the fleein' pawtent o' Hen's son, an' the balloon handin' up the coal depôt, wi' St. Paul's far below. It 's capital!

Montgomery. There is something over the leaf.—(*Reads.*)

"TO THE
WITTY, TALENTED, AND ENTERPRISING MEMBERS
OF THE 'ARTIZAN CLUB,'
('Specially 'Gray'),
THE SUBJOINED ENGRAVING
(See t'other side,)
Which is done in the first style of the Art,
(Drawn on paper by A. Pen, and engraved by A. Tool, A.R.A.'s,)
IS MOST RESPECTFULLY DEDICATED
BY THEIR OBEDIENT SERVANT, FRIEND, AND WELLWISHER,
NICODEMUS THUNDER BOLT."

Scalpel. It is really very clever.

Gray. It 's jist uncommon. I houp that chiel will send us some mae o' his diversions. Off the perpendicular—that puts me in min' that Gairdner has ncgleckit the glesses. I'll jist gie a rug at the bell.

(*The speaker, in rising, shakes the chandelier—the Bude-light explodes; and after much consternation and re-composure, the meeting adjourns.*)

Art. VII.—ECCLESIASTICAL ARCHITECTURE.

Anglican Church Architecture; with some Remarks upon Ecclesiastical Furniture. By James Barr, Architect. Oxford. Parker. 1843.

Gothic architecture has certainly come into greatly increased consideration within the present century, and now occupies a higher position in the public eye than it has reached since the time of Elizabeth. The change is, no doubt, connected with the altered tone of our literature, and that general declension of classical learning which was the consequence of its undue exaltation. But it is also, to a considerable extent, the effect of the backsliding of a large portion of the clergy of our Established Church into the dogmas and superstitions of a former age; and of which superstitions, certain architectural observances are taken to be the symbols. The doctrines and discipline of the ancient church are conceived to have some necessary connexion with the architectural modes to which it was addicted; and a sacredness is thus given to the Gothic style to which, in strictness, it has not a particle of right. While, therefore, the Gothic style finds favour in some eyes, because it is the product, to a certain extent, of our own country, it is hallowed in the minds of others by its connexion with the purposes of religion; and the restoration of our churches to their ancient condition is conceived to be indispensable to the restoration of our faith to its ancient purity.

The first of these motives is, in our judgment, both a legitimate and harmless one: the second is the symptom of a dangerous spirit, and naturally leads to the most abject superstition. We do not, indeed, suppose that there is anything objectionable in architectural embellishment, or in any degree of pomp and grandeur in religious ceremonial; but we think that a scrupulous regard to the minutiæ of such matters—the assignment of certain forms, and situations for stools, and fonts, and pulpits, has a tendency to impart mystical and superstitious impressions respecting those objects to ordinary minds, and make men worship the shadow instead of the substance. We are, therefore, altogether adverse to the prescriptions of the dark ages relative to the internal arrangements of churches, as well as to their style of architecture being rigorously followed. Old buildings should, of course, be restored in the spirit of the original; but we think nothing can be more absurd than to stick by old plans in the case of new constructions: it is just as if an engineer were to give a preference to the engines of Savery or Newcomen over those of Messrs. Maudslay and Field.

This adherence to old plans, however, has found many advocates, and Mr. Barr is one of the best of them. He carries, it is true, but little weight of metal; but he is discreet and modest, and takes care not to offend people by a needless intolerance. If he does not do very much good to the cause he advocates, he at least does it no harm; and we question whether he does not do it all the good of which such a cause is directly susceptible. It is little the mere architect can do in reviving an affection for any particular style, inasmuch as that affection is generally due to causes which lie without the architect's province; and the final emotion can no more be awakened without the aid of those which go before it, than a problem in geometry can be solved without the aid of the preceding ones. It is, perhaps, in this conviction that societies have been established in Oxford and Cambridge, which, under the pretence of teaching architecture, actually teach theology. Their professed aim is to awaken a more correct architectural taste respecting ecclesiastical constructions; but a true taste is predicated to consist in an affection for the architectural modes of the twelfth century; and the means adopted to awaken that affection, are quite as well calculated to awaken an affection for the religious modes and doctrines then prevailing. These societies are, therefore, in reality *schools of dissent.* We do not conceive, however, that they have exercised much influence upon the taste or religion of the people; and they will, we believe, cease to exercise any, so soon as their true designs become fully known. The public taste is, no doubt, dissatisfied with the Roman and Grecian styles, and has made use of the Gothic to free itself from their bondage; but in the Gothic it cannot rest; and it will, we believe, continue to waver until some new modes have been invented which will be representative of the skill and science of the present day.

It has long been the custom of the idolaters of the Gothic, to lavish an extraordinary amount of praise upon the skill and science of the ancient builders, which has no parallel, it is contended in the present time. From this judgment, however, we must dissent, for although the proficiency of the ancient builders in cathedral building is indubitable, and, perhaps, exceeds that of the moderns; yet, in those other branches of the art, in which the genius of the people has now found an exercise, the modern is greatly superior to the ancient practice. The freemasons, with all their skill in arch-building, could not, we are confident, have built New London Bridge, or the skew arch of a railway; but there is no cathedral arch, which a modern builder could not quite well execute; and, although we are ready to admit that the balance of proficiency in cathedral building lies with our fathers, yet this is solely because, there is now no demand for that species of construction. It is not from any retrogression in the ability of our builders, that the superiority of the freemasons in this particular department of art is attributable, but to the circumstance of that ability having found a different channel, and one such as is required by the spirit of the age. We must, however, now enable our readers to form a judgment of Mr. Barr's book.

Although, Mr. Barr professes to treat of Anglican church architecture, it is of the Gothic style of architecture alone, that he says anything. The work is divided into a number of chapters, each of which contains an account of some particular part of a church, such as the roof, the spire, the windows, &c. This plan conduces to make the work precise and practical, but when conjoined with Mr. Barr's peculiar views, relative to the importance and religious significancy of a number of petty observances convert the work into a mere receipt book for *making* a church. We give the following specimens: they are worthy of Mrs. Glasse, or the Cook's Oracle.

> "The chancel being that essential portion of the sacred edifice, which is set apart for the most solemn and impressive administration of the Holy Eucharist, should always be designed of spacious and dignified proportions.
>
> "The chancel-floor ought to be on a higher level than that of any other part of the building, and should be paved with encaustic tiles covered with appropriate devices.
>
> "The nave ought to be kept subservient to the chancel; and, being of more imposing dimensions, should not, therefore, be so richly ornamented.
>
> "The door-ways of the church ought not to be introduced in any of the elevations that face the east.
>
> "When seats are introduced in the chancel, they should be arranged lengthwise, with their backs to the wall, and low desks in front of them, *with poppies at each end.*"

We might multiply these examples almost indefinitely. Our readers will probably, agree with us, in thinking that such minute and particular directions respecting matters wholly unimportant is calculated to encourage superstition in ordinary minds, and is, therefore, to be discountenanced and discouraged. When it is made a *sine quâ non,* that the seats shall have poppies on each end, the natural inference is, that there must be some peculiar virtue in the poppy, and that nothing else will do. The poppy assumes a new character in the vulgar eye, and becomes not a mere piece of decoration, but something mystical and sacred. This is the danger which waits upon the introduction of decoration, and to which all ornament, the nature of which is *fixed by rule,* immediately leads. Such kinds of ornament can give no impulse to the fine arts, for they exclude invention, and if once accepted by the people, could hardly fail to end in the grossest superstition. Of this, however, there is little danger, the intelligence of the age has outgrown the credulity of the Monks of Oxford, and will resist their *poppies* as successfully as it has long resisted their still weightier narcotics.

Mr. Barr's work closes with an account of the early Christian symbols, on the revival of which, in the decoration of churches, he and the rest of his school are so intent. He says,—

> "The representations found on the tombs of the early Christians in the catacombs at Rome, may perhaps be considered as authority for the subjects that may with propriety be used in decorating the walls or the windows of fabrics belonging to the Anglican Church; which is professedly re-formed on the model of the Christian Church in the three first centuries. It may therefore be useful here to enumerate those most commonly met with."

Now, we think, it should abate the solicitude of those who are labouring for the re-introduction of these symbols, to be informed that, they were almost all the *emblems of heathen deities,* and were brought into the Christian from the pagan faith. We, therefore, give them the following references to Hope's Essay on Architecture, where they will find abundant proof of the truth of this assertion.

> *The vine and the* rites of Bacchus rendered symbolical of the vineyard of the faith.
> Rome . . . S. Constantia.
> S. Laurence.
> *The ear of corn,* of Ceres, became the emblem of the bread of the last supper.
> *Palm branch of Victory,* marked the triumph of martyrdom.
> *Venus,* Dove, became the Holy Ghost.
> *Diana's* Stag, the Christian's soul thirsting for the living waters.
> *Juno's* Peacock, under the name of Phœnix, the soul after the resurrection.
> Jupiter's Eagle an Evangelist.
> Cybele's Lion, another.
> Body of Christ exhibited on the cross in the sixth century.
> At Ravenna all these emblems are to be seen.
> The lamb, the dove, the deer, the goose, the peacock, and the fish, appears on the convex marble ambones—still inserted in the walls of the modern cathedral."

It was not, however, in their symbols, merely, that the early Christians imitated the Pagans, as will appear from the following:—

> "Each favourite heathen custom of the capital of the world acquired its parallel in Christianity.
> *The idolatrous Romans* sprinkled the place as well as persons, at their religious rites, with water, called Lustral—the Christians likewise had their holy water.
> ——— When performing sacrifices and other rites, used to light lamps and torches—the Christians lighted tapers, and carried them in processions in the very face of the sun.
> ——— Burned frankincense and other perfumes, in honour of their gods—their Christian successors did the same for the saints.
> ——— Had to bribe their gods by the promise of certain offerings. The Christians made similar vows to their saints—and when attended with success, the thing vowed was hung in their chapels, round their altars.
> ——— At the winter Solstice had a festival to the goddess Strenua,—the Christians did the same, continuing the gifts, called by the French '*étrennes.*'
> ——— Had their Saturnalia—the Christians continued the fashion in their Carnival; its masks, its revels, and its licence.

The idolatrous Romans, on the 1st of May, celebrated the return of spring, by a tall erect pole hung with garlands—the Christians had their May-pole.

———— Celebrated with different solemnities, the entrance into the summer Solstice—the Christians fixed the same day for the celebration of the Apostle St. John; and continued to light, as Christians, the bonfires they had before kindled as Pagans.

———— Had priestesses who vowed perpetual virginity—which custom the Christians imitated in their religious orders.

The Tunic of the Priest, the Lituus of the Augur, and Cap of the Flamen of Pagan Rome, were preserved in the Dalmatic, the Mitre, the Staff, and the Crosier of Christian Bishops."

We leave it to Mr. Barr's ingenuity after all this, to find out what great Christian solemnity there can be in the emblems, the revival of which he advocates.

Art. VIII.—MANAGEMENT OF RAILWAYS.

Railways, their uses and Management. London: Pelham, Richardson. 1842.

This is a small pamphlet of 65 pages, and treats of nearly all the railways in the kingdom—their cost, construction, management, and mismanagement, and in short of all that concerns them, whether as regards engineering, finance, or political economy. The subjects, however, are so various, and at the same time so promiscuously mingled that it is difficult to discover the purpose of their discussion. After reading the sixty-five pages through, we are utterly at a loss to say what was the author's object in writing them, unless it was merely to produce sixty-five pages of print. If that was his intention he has accomplished it and no more; and that evinces on the part of an author, no ordinary degree both of ability and discretion.

Art. IX.—WHITELAW'S WATER MILL.

Description of Whitelaw and Stirrat's Patent Water Mill; with an Account of the Performances of a number of these Machines. By James Whitelaw. London: Mechanics' Magazine Office, and Office of the Artizan. Glasgow: David Robertson, and Office of the Practical Mechanic. 1843.

The purpose of this little work is, to make known to those interested in the applications of hydraulic power, the merit of a species of Barker's Mill, invented by Mr. Whitelaw, and which in practice is found to give the most satisfactory results. The chief objection to the common overshot wheel is its great size and formidable cost, to which might be added the loss of power consequent on the friction of the gearing requisite for bringing up the speed of the prime mover, to the velocity indispensable to most ordinary mechanical operations. These objections do not apply to this contrivance; the machine occupies but a very small space in comparison with a water-wheel on the same power; its speed is high, and the expense of its construction greatly inferior to that of any other effectual mechanism for deriving a rotatory motion from a head of water. The amount of power it realizes is, from 74 to 79 per cent. of the whole power of the water passing through the mill, so that as regards economy of water, this machine stands at about the same level as the best overshot wheels, without however involving a loss of power from the friction of the gearing.

The arms of the machine are bent in the form of an Archimedes spiral, so as to obviate the communication of a centrifugal force to the water, which if the arms were straight, it would necessarily acquire to the diminution of the useful effect. Any number of arms may be used, but two is the common number. The machine, of course, revolves horizontally, the water *ascending* into the horizontal arms through an upright pipe, upon which a short pipe, to which the arms are fixed, revolves, the escape of the water being prevented by a water-tight joint. The effluence of the water at the orifices of the arms, is regulated by means of valves of a peculiar description, governed by the centrifugal force of the machine, or in other words by its velocity.

One of these machines was lately erected at the Chard Canal, for hauling the boats up an inclined plane. We must, however, leave Mr. Whitelaw to state the nature of the performance.

"The plane has a rise of 1 foot perpendicular in 10 horizontal. The weight of the boat, cargo, and the cradle in which the boat rests, is 18 tons; and, when the machine is fairly started and working up to its speed, this weight is raised 16·9 feet perpendicular each minute. The height of the fall which works the water-mill is 25 feet, and 725 cubic feet per minute is the quantity of water used by the machine. Now, $725 \times 62{\cdot}3 \times 25 = 1129187{\cdot}5$ will represent the power of the water, and the power of the water-mill will be represented by $18 \times 20 \times 112 \times 16{\cdot}9 = 681408$.—$\therefore 1129187{\cdot}5 : 681408 :: 100 : 60{\cdot}35$; that is, the machine gives 60·35 per cent. of the power of the water which works it: and, in addition to this, it overcomes the friction of the other machinery, which takes the boat up the inclined plane.

"Mr. Sydney Hall, who, under Mr. Cubitt, superintended the works on the canal, and who, with great care, experimented on the machine, in his report on the subject, estimates, that 96 of the 725 cubic feet of water used by the machine are lost by the escape at the water-tight joint. But, supposing this loss of water to amount to 75 cubic feet per minute, then 650 cubic feet of water will be left to work the machine. Now, if 650 cubic feet be the quantity of water expended at the jets, the result will be a power equal to 67·3 per cent. of the power of the water used by the machine. This will be evident by making a calculation in the manner done above. This last is a very great result, for, if we suppose the power of the machine to be 75 per cent., then 7·7 per cent. only will be the quantity of power required to overcome the friction of bevel-wheels, shafts, drums, guide-pulleys, cradle-axles, and the other parts of the machinery which work the plane, and which do not form a part of the water-mill. Even if 725 cubic feet of water were used by the machine, only 14·65 per cent. of the power of the water would be needed to overcome the friction of the machinery for working the plane, and which does not form part of the water-mill, allowing the machine to give 75 per cent. of the power of the water."

The diameter of this machine, measuring from centre to centre of the jet pipes is 9·55 feet. The diameter of the main pipe is 26ins.—of the arms 12ins., and of each jet ·412 of a foot. The number of revolutions per minute is from 60 to 63. The advantages of this machine over a water-wheel of the best kind, Mr. Whitelaw says, are the following:—

"The new mill has a governing apparatus, which renders its motion as uniform as that of the best constructed steam-engine: when a part, or even the whole, of the machinery which it works is thrown off at once, the variation in the speed is scarcely perceptible. The speed of the new machine is well suited for every purpose: generally, it can be formed to make the required number of turns in a given time, and on this account, intermediate gearing is done away with. There is little wear and tear of the parts of the new mill, for its weight being perfectly balanced by that of the water, the friction is taken almost wholly away, and consequently the wear of the rubbing parts is correspondingly reduced. In proof of this I may state, that a great many of these machines are already in operation, and not a workman has been employed in any way at any of those first made, since they were erected, although one has been in constant use for more than four years. The machine takes up remarkably little room. No very expensive building or other erection is needed for fixing the new water-mill, and its cost is very trifling especially on a high fall, whereas an overshot wheel, with the building, excavation &c., required for it, is enormously expensive. The new machine may easily be made to rise or fall according as the water in the tail-race is high or low, and one form of it works to very considerable advantage in tail-water. The best constructed overshot water-wheel will not, after the speed is brought up for ordinary purposes, give more than 70 per cent. of the whole power of the water which works it; and the new machine, as has already been shown, gives at least 75 per cent., and it can be formed to give even a higher result."

The only machine which can come into any sort of competition with this is the turbine of Fourneyron, but of the two, we believe, this to be much the superior. It is easier made—easier kept in order, and realizes a larger amount of the power of the water. The principle of the contrivance, we may almost say is perfect, and its details exhibit a rare combination of the soundest judgment, with fertile and refined invention.

Art. X.—PILBROW'S PATENT INJECT STEAM ENGINE.

We have given in Plates XIII. and XIV. some drawings illustrative of the principles of action of a new species of steam engine which has lately been patented by Mr. Pilbrow. This engine belongs to the class of rotatory engines, but in principle is completely distinct from all other engines now in use, as it is proposed to be wrought entirely by the impulsive action of steam issuing from an orifice. It will be best described by the following extracts from the specification of Mr. Pilbrow's patent:—

"The properties of steam have hitherto been considered of that peculiar nature as to render it impossible to obtain its full power and extreme duty from expansion, except by using it according to the present system; that is, by letting it into a hot and close cylinder on a piston, and stopping its further entrance by cutting it off, to allow it to expand. Feeling, however, a strong conviction that the whole power was to be obtained by some more simple means than the present costly, complicated, and ponderous machinery, and that a power so easily raised need not be so laboriously applied, I undertook a long series of experiments to discover how this might be done. I first commenced on the most simple form of engine known to us, that of Hero's, and ascertained the true causes of its loss of power; and found, after many inventions to obtain from this simple machine the full power and duty from expansion, that, though I could considerably increase its power by the form of arm shown in fig. 1, (a spiral form of arm,) yet that I could not obtain the whole duty from expansion; and, consequently, that an engine on this principle could never be brought to compete with Mr. Watt's condensing engine. The failure, however, of my plans to obtain these results, disclosed to me the remarkable fact, that a current of steam in rapid motion—that is, issuing from an orifice—loses (almost entirely for practical purposes) that power from lateral expansion which it possesses when cut off and allowed to expand in a cylinder. When I had confirmed this phenomenon by other experiments, I was satisfied that steam possessed an impulsive power of the utmost efficiency, entirely different from what had ever been supposed; for, its full expansive force not being given out laterally, must have gone somewhere; and, as it could only expand in the line of its issue, I became acquainted with this new and singular property of steam, that it possessed, in its mere velocity alone, a propulsive force from its lineal expansibility equal in power and duty to the gross effect obtained when cut off and allowed to expand under the best circumstances. I had next to transmit this new principle of steam power to machinery, with the least possible loss from friction and other deductions, by some engine as simple as the principle; and this I supplied as hereinafter described. Having found, however, that there is as great a difference in the duty of steam, by the peculiar manner in which it is applied by its velocity, as is found in effect in the application of water, I shall first describe a few experiments, being some of those which led to my invention, to show the accuracy required. The operation of Barker's mill, and of Hero's emission engine, is well known; and though there is no resemblance between their moving powers—the one acting by gravity, the other by repulsion—there seems to be a strict analogy between their results, proportioned to the power and velocity of each; so that, whether water or steam be used in the following experiments, the modes of action being similar (that of impulse or transference of motion), the operation and direction of the arm will be the same: and it will be seen hereafter, that I obtain, by my application of the velocity of steam, the same duty therefrom as is obtained by the best overshot water-wheel—namely, a clear available effect of about two-thirds at least of the whole power of the steam employed; that is, two-thirds of its power and of its extreme duty from expansion; the steam being expanded, in my application of it, as low as the atmosphere in high-pressure engines, and to the vapour-point, or state of condenser vacuum, in condensing engines; degrees of attenuation which cannot be obtained by the present system, on account of the piston.

"Figs. 2 and 3, in Plate XIV., represent arms on Hero's principle, attached in the usual way to a hollow axle (*a* or *b*,) supplied with steam, and having orifices at the extremities *c* and *d*. When used in the usual way, the arms will revolve by unbalanced pressure in the direction of the arrows *e* and *f*; but when a flat plate is attached immediately before the orifice *g*, fig. 2, the steam will impinge thereon, and, being broken up, will change its course as therein represented, and the arm will become stationary; showing that the force of impingement equals that of unbalanced pressure. If, however, a cavity (*h*, fig. 3) be fixed, instead of the plate, opposite the orifice, at such an angle that the injet of steam can be returned by its reaction *i*, clear of the arm, without impinging thereon, the arm will revolve in the contrary direction to that of the previous unbalanced pressure, and in the direction of the arrow *j*, with more power than that with which it revolved the contrary way previous to the cavity *h* being fixed thereon; proving that the cavity not only received the same amount of impingement as the flat plate *g*, fig. 2, received, (which was shown to be at least equal to the unbalanced pressure), but by this peculiar injet and reaction (or reissue of the steam) its *whole velocity* was *arrested*, and the cavity thus acquired another power of equal amount, sufficient to overcome the effect of unbalanced pressure only. But if the steam, on its reissue or reaction from the cavity *h*, is permitted to impinge at all against the arm *d*, the arm will then only revolve in the direction of the arrow *j* with diminished power, in proportion to the amount of such impingement; and if all the steam on its reissue or reaction from the cavity *h* is allowed, by altering the angle of the cavity, to strike fully against the arm *d*, the arm will then remain stationary as when the flat plate *g*, fig. 2, was used.

"When I had discovered how this double power was to be obtained by arresting and transferring the whole velocity of the steam by such peculiar injet, and its clear reaction or reissue, and how its full effect might be impaired or wholly neutralized, as just described, I found myself possessed of a new method of applying the power of steam by its velocity alone; and this became the germ or principle of my improvements in the steam engine; for, to carry it out, I had only to invent such machinery as would give me this double power in the same direction of motion, without deduction for the unbalanced pressure in the experimental arm *d*, to counteract the full effect of the whole force of the velocity, and also without loss of power from another source—that of my back-action or impingement of steam against the backs of the cavity next in succession. The following, therefore, is a description of the engine or apparatus by which I propose to effect these objects:—

"Fig. 1, Plate XIII., is a section of a case, *a a a a* showing a wheel *b* fitting within about half an inch all round, and revolving therein with the axle *c*. This case, for a high-pressure engine, may be made of cast or sheet-iron, of suitable thickness to resist the pressure of the atmosphere caused by a partial vacuum from the rapid action of the steam-wheel. The whole of the inside I prefer should be polished, or made perfectly smooth, to prevent friction of the used steam when it reissues from the cavities. For a condensing engine, the case must be made strong enough to resist the atmospheric pressure. At those parts where the jets of steam are admitted, several cavities *d d* are made with or attached to the inside circumference of the case, for the purpose of receiving the used steam, and returning the same into the cavities of the steam-wheel; and where a double row of cavities are used round the steam-wheel, the rows of cavities in the case must be reversed accordingly. These cavities in the case must be placed in such a position to the cavities of the steam-wheel, that, on the used steam issuing therefrom and rushing into the cavities of the case, it may be returned therefrom into the cavities on the steam-wheel at the same angle as that at which the steam first issued from the jet-pipes, and the used steam will then, as the wheel revolves, be thrown out at the eduction passage *e*.

"The periphery of the steam wheel is formed by a series of cavities all round of the same dimensions, shown by the dotted lines, for the reception of one or more jets of steam. The size of the cavities represented in the wheel is three quarters of an inch deep, by one and a half long, and half an inch wide, and which are better shown on an enlarged scale by figs. 2 and 3."

These extracts sufficiently explain the principle and general arrangement of Mr. Pilbrow's engine. The following gives that gentleman's ideas as to the velocity and power of the engine, represented in the drawing.

"The figures in Plate XIII., to which the foregoing description refers, are laid down to a scale of two inches to a foot, and are those proportions of my engine which are intended for a locomotive boiler, which evaporates about 60 cubic feet of water in an hour, at 60lbs. pressure per square inch above the atmosphere. Such a steam wheel revolving at 34,830 feet per minute, at about which velocity I prefer the periphery of my engine, at such pressure, to revolve (when it is not found desirable to have a slower action as hereinafter described), will, I think, give about the net actual power of 153 horses, after deducting the loss by the velocity of the steam wheel." In Plate XIII, is shown the application of the plan to a locomotive.

The experimental data, from which Mr. Pilbrow calculates the power of his engine, are contained in the following Table, which, with the observations prefixed, we extract from his specification.

"The following Table of pressures will show the proper force of or impulsive effect from the simple expansive velocity of steam rushing, (on my principle) into a stationary cavity, unenclosed in the open air of the engine-room. The orifice of discharge was fully $\frac{3}{8}$in. in diameter, or about the ninth of a square inch, and the cavity of the form described in drawing (C). The pipe was 19ft. 6in., and the nozzle very tapering.

"Steam above the atmosphere at the orifice of the pipe."	"Actual result from an orifice of $\frac{3}{8}$in. diameter."	
lbs.	lbs.	oz.
10	2	5
15	4	1
20	5	3
25	6	7
30	7	9
35	8	9
40	10	1
45	11	3
50	12	7
55	13	8
60	15	4

The method adopted to determine the best velocity is this: The velocity with which steam at 60lbs. pressure above the atmosphere rushes through an orifice is known experimentally to be about 104,490 feet per minute. The difference between this and the velocity of the periphery of the wheel, gives the velocity of impact of the steam on the cavities of the steam wheel, and the power or pressure exerted on the wheel, being proportional to the square of the velocity of impact, the power of the engine can be calculated for various velocities of the wheel. Mr. Pilbrow has done this, and finds that "the greatest results are obtained when the wheel revolves at precisely one third of the velocity of the steam, or 34,830 feet per minute."

We have now given sufficiently copious extracts from Mr. Pilbrow's specification, to explain the principal features of his new engine. Our opinion of his invention is, that it will not succeed, or in other words, that, by the plan proposed, he will not be able to make a good, durable, and economical engine. Of this we are *certain*, that Mr. Pilbrow has not yet, so far as we have ascertained, proved that his engine will realize the tenth part of the power he anticipates from it. To make a few experiments on the force of impact of a jet of steam on surfaces at rest, and from that to theorize on the mechanical effect of steam rushing into and rebounding from cavities in rapid motion;—to calculate the velocity of impact on one surface, and of rebound from another, as if it were a solid and *perfectly* elastic body, whose laws of motion are exactly known, is a method of proceeding that can only lead to error, or at least can never bring us with certainty to the truth. We are, however, ready to admit that we are unable to demonstrate *à priori* the absurdity of the proposed improvements, and the same uncertainty that attaches to Mr. Pilbrow's arguments in favour of his engine affects in a minor degree ours against it. Such as they are, some of them may be shortly indicated, as follows.

We agree with Mr. Pilbrow, that the whole power of the steam is expanded in giving velocity to its own particles, and, *theoretically speaking*, the same power ought to be extractible from them. In Mr. Pilbrow's engine, however, we have seen that the periphery of the wheel is to move with one third of the velocity of the steam, leaving only two-thirds of the velocity to produce mechanical power. Now, Mr. Pilbrow himself says, that the mechanical power produced is proportional to the square of the velocity of impact, and the square of $\frac{2}{3}$ is $\frac{4}{9}$, or scarcely one half. So that here is fully one-half of the whole mechanical effect dissipated at once; but this is not all, for when the steam strikes the periphery of the wheel, with two-thirds of its actual velocity, it must, by the laws of elastic bodies, rebound with the same velocity from the wheel; that is, it will rebound with an actual velocity of one-third, while the wheel moves in the opposite direction with an equal velocity. There is, therefore, this velocity of one-third of its original velocity still remaining in the steam, and unextracted after impact. One-third of the velocity corresponds to one-ninth of the mechanical effect. This, therefore, is also lost.

Another great objection to the new engine is, the enormous velocity that is proposed to be given to the steam wheel. This objection alone, we conceive to be fatal. A velocity of 34,830 feet per minute at the periphery, corresponds with 3,166 revolutions per minute—a velocity sufficient to make any such machine fly to pieces.

Mr. Pilbrow himself could not avoid seeing this objection, and accordingly he has attempted to prescribe a remedy. He proposes to make the wheel go slower, by which means the steam will rebound from its periphery with a correspondingly greater velocity, and is to be made to impinge on a cavity in the case similar to those in the wheel. From this it will again rebound, and strike the wheel, and again be returned to another cavity in the case, and thence once more impinge on the wheel. These alternate oscillations from the wheel to the case, and from the case to the wheel, are to be continued till the velocity of the steam has been entirely expended in imparting power to the wheel. We believe, few persons will be able to refrain from a smile, when they contemplate the steam performing these merry-andrew-like gyrations. We suspect that it will be more apt to take one long jump to the exhausting port, and make its way off the stage as quickly as possible, rather than stop to perform so many ingenious evolutions. It is but justice to Mr. Pilbrow to say, that he is very doubtful of the success of this part of his plan. His having ventured to propose it at all is a strong proof to us that he felt very strongly the force of our objection to the enormous velocity proposed to be given to his steam wheel.

Art. XI.—PADDLE-BOX BOATS.

A great agitation has been made lately respecting the merits of boats on the tops of the paddle-boxes of steam vessels—as if boats carried in that situation had a virtue all their own, and which did not extend to boats carried in less difficult situations. It appears very clear to us that the paddle-box is just one of the very worst situations in which a boat can be carried; and, instead of making a law to make every steamer to have boats carried there, it would be much more sensible to compel every vessel so fitted to carry either an extra supply of boats, or carry those boats in less absurd situations. There is nothing which shows the force of quackery more strongly than the favour with which these silly appliances have been viewed in certain quarters. We shall do what we can to burst the bubble, and we trust other journalists will follow our example.

And first, we may observe, that it seems a preposterous thing for Captain Smith, or any body else, to claim *as an invention* the plan of making the paddle-box top into the form of a boat. The tops of the deck-houses, the companions, and a thousand other things, might be made into a boat quite as well; and would any such a transformation involve the exercise of any inventive genius, or justify the claim to an exclusive right or patent? It would be as absurd to pretend that a man could claim a patent for dressing his hair with oil and vinegar, instead of with Rowland's Macassar.

But these boats are not only destitute of any claim to a monopoly which people are to be forced to accept, and forced to pay for; they are very bad things, and should not be permitted, even if they were to be had for nothing. What is the situation of a vessel in those cases in which boats will most probably be required? In all probability she will be rolling heavily; and who is there does not see that, in such a case, these boats would be almost unapproachable? The motion of the vessel, when rolling in a situation so far removed from the centre, and so high up as the paddle-box top, is necessarily very great; and, on the top of the paddle-box being lifted off, the sea would fly up through the paddle-box with great force. It is very well known that the force of the sea sometimes even bursts off the hasps which keep down the paddle-box top in ordinary vessels: and who would go near the paddle-box boats to turn them over, or into them when turned over, in such a state of the sea? Even in the river it is a troublesome thing to launch these boats and get into them: in a sea-way it would be impossible.

There is another source of peculiar danger in the use of these boats, arising from their proximity, when launched, to the paddle-wheel. The smallest movement of the wheel, either forward or aft, might catch the boat as it reached the water, and perhaps sink it: and such movements of the engine are scarcely to be avoided in a sea-way, as the mere action of the waves on the wheels will move the engines. The engines, indeed, might be lashed firmly, to prevent them from moving; but, in the emergencies in which boats are wanted, there is no time for such operations; and to lash the engines might place the ship in a double jeopardy, by disenabling her to make such a movement ahead or astern on the instant as might be indispensable to her safety. For our parts, we think the ordinary supply of boats is sufficient; but if they must be increased, the best way, it appears to us, would be to put the ordinary boats within other boats of zincked iron, which might be hung from the same davits, though with different tackles, so that either the iron or the wooden boat might be lowered as was desired. The iron boat could not, of course, have fixed seats; the seats should be so placed, either in the bottom of the boat or some other part, that they might be shipped without trouble. Any *number* of boats might be thus carried: if larger boats were requisite, they might be carried on the grating behind the paddle-box, either with their open parts against the bulwark and keels projecting out, or in any other way that might be found the most convenient in particular vessels.

Art. XII.—BOILERS OF THE 'DEE' AND 'SOLWAY.'

These boilers, which are shown in Plate XV., were made by Messrs. Scott, Sinclair, and Co., of Greenock. The boilers for the two vessels are identical, with the exception that those for the 'Dee,' instead of being *each* rounded on the top, are made with their tops coincident with a sweep drawn from outside to outside of each wing boiler, so that the tops of the three boilers conjointly form a portion of an ellipse.

Fig. 1 is a perpendicular section through the chimney.
Fig. 2. Horizontal section.
Fig. 3. Front view of boilers of 'Solway.'
Fig. 4. Perpendicular section through flues.

There are a double tier of furnaces, making eighteen in all. The plan of double furnaces is a bad one.

The diameter of cylinders of 'Dee' and 'Solway' is 73 inches; length of stroke, 7 feet; nominal horses'-power, 400; total fire surface, 46850·4 square inches; total heating surface, 4156 square feet; weight of each boiler, 27tons 10cwt. 2qrs. 3lbs.; total weight of boilers, 82tons 11cwt. 2qrs. 11lbs.; fire surface per horse-power, 117 square inches; heating surface per horse-power, 10·3 square feet.

A A, furnaces; B B, water spaces; C C, bridges, which are of brick, the best material for constructing them of; D D, lower flues; E E, upper flues; F, the chimney.

The same letters refer to the same parts in all the figures.

Art. XIII.—ANATOMY OF THE STEAM ENGINE. No. 5.

CYLINDERS.

The plan of making cylinders with jackets, or with steam casings, is now nearly extinct. The jacket causes the cylinder to be a much more difficult casting, without being of the least service in any way. It appears to be much the best plan to deliver the steam at once into the valve-casing; and in steam-vessels it is more convenient that this should be done on the sides of the respective engines which are next the sides of the ship.

For cylinders up to about 60 inches in diameter, it appears to be the best plan to cast the bottom in, with proper feathers to support it, and a hole for the boring-bar to pass through, afterwards fitted with a plug. Above that size, we should prefer casting the cylinder open at the bottom, and making the bottom out of the sole-plate. A projection should be cast on the sole-plate, to go a certain distance into the cylinder, with a space hollowed out for the cylinder-port. The bottom joint should not be of rust, but metal to metal; the bottom flange of the cylinder and the place on which it stands on the sole-plate being both faced in the boring-mill. The cylinder-cover flange, and the top flange of the cylinder, should fit so nicely together that they will be tight by interposing a piece of lead.

The valve-casing should be attached to the cylinder by means of a metallic joint, or, in other words, by fitting the surfaces so accurately that a little red-lead interposed will make them tight. The valve casing can thus be easily removed at any time to repair the valve faces; whereas, if the joint of the casing be of rust, the removal of the casing is an operation of much difficulty.

The attachments of the cylinder to the diagonal stay are very generally made too small—that is, the surface is too small, and the flange too thick. A very thick flange cast on any particular part of a cylinder endangers the soundness of the cylinder by inducing an unequal contraction. It is much the best way to make the flange for the framing thin, and the surface large. The bolts, too, should be turned bolts, and nicely fitted. Some persons make them with a nut at both ends, the body of the bolt being made with a little taper; and the nut which answers to the head is screwed up after the conical part of the bolt has been drawn into the hole by the nut at the point. The object of this plan is to facilitate the fitting; but if the fitting be well done, it is unimportant whether it is done in this way or any other.

VALVE FACES.

Numerous varieties of metal have been used for valve faces, and in different modes of application. It appears to us, however, that, upon the whole, the best way is to make the faces of the valve, iron, and the faces of the cylinder brass. The iron is the metal most likely to be damaged by the steam; and, by putting the iron in the valve face, it admits of more easy reparation than if adopted for the cylinder face, which cannot be effectually re-adjusted without taking off the valve casing.

The mode in which the steam affects the iron, is by making the surface rough—the face assuming a granular appearance, something like loaf-sugar. This action shows itself only at particular spots, and chiefly about the angles of the port, or valve face. At first the action is slow; but, once the steam has worked a passage for itself, the cutting-away becomes very rapid, and in a short time it will be impossible to prevent the engine from heating when stopped, owing to the leakage of steam through the valve into the condenser.

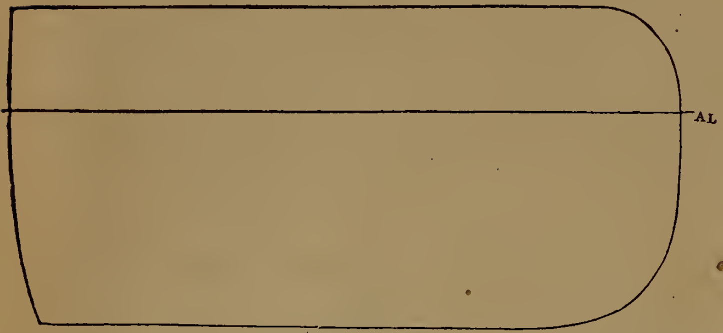
Art. XIV.—PHYSIOLOGY OF THE STEAM ENGINE. No. 5.

We give two diagrams, taken from the cylinder and air-pump of the 'City of Aberdeen' steamer since the appearance of our last Number, by Mr. R. Leys, the engineer of that vessel. The vessel, during the voyage on which these diagrams were taken, was very deeply laden, so that the engines were only going at the rate of about twelve strokes per minute.

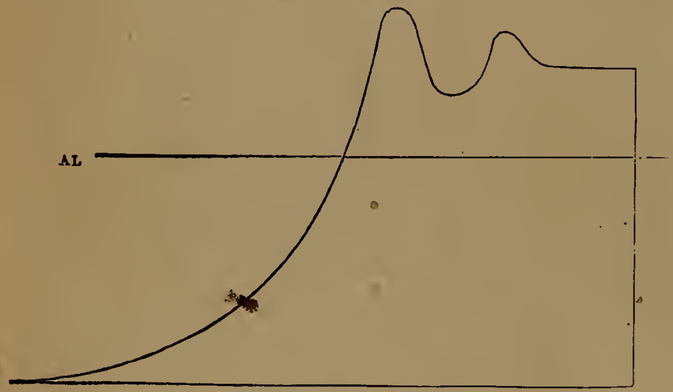
The following are some of the dimensions of those parts of the engines which have connexion with the quality of the diagrams:—

Diameter of cylinder, 62 inches; length of stroke, 5ft. 6in.; size of ports, 25 × 5½in.; stroke of valve, 11in.; cover on steam side, 1½in.; cover on eduction side, 0; pressure of steam, 7lbs. per square inch; valve set ¼th of an inch open when the crank is on the centre; diameter of air-pump, 37in.; length of stroke of ditto, 3ft.; diameter of waste-water pipe, 12in.; height of mouth of discharge-pipe above delivery-valve, 7ft. 8in.

Cylinder Diagram.



Air-pump Diagram.



A L *stands for Atmospheric Line.*

The indicator used was one of M'Naught's, on the scale of which one-tenth of an inch represents a pound of pressure.

The above diagrams were taken in smooth water. Mr. Leys has also sent us two taken during the same voyage in a tempestuous sea. The cylinder diagram, under these latter circumstances, is just the same as before; but the air-pump diagram, instead of being composed of a single curve, is composed of a vast number of parallel curves, showing a perpetual variation in the air-pump resistance. The mean of these curves is, as nearly as possible, the same as the one given; so that the nature of the air-pump diagram, taken in a rough sea, may be conceived by supposing a number of diagrams drawn some within and others without the one we have given, with a distance of ¼th or ⅜ths of an inch between the extreme inside and outside diagrams. These diagrams are more intelligible, and, we think, a nearer approach to the average of ordinary working, than those we gave in our last Number.

Art. XV.—ANALYSIS OF BOOKS.

The Student's Guide to the Practice of Measuring and Valuing Artificers' Works. By a late eminent Surveyor. London: Weale. 1843.

This is one of the most practical works we have met with for a long time, and cannot fail to be acceptable to the young surveyor, and, indeed, to many who are neither young nor without experience. It gives the most approved routine for measuring the work of every building artificer, and the directions are laid down with great plainness and precision: in short, it is a work we can safely recommend.

Popular Cyclopedia of Natural Science. Part IV. Horology and Astronomy. By W. B. Carpenter, M.D. London. Orr and Co. 1843.

The present volume of this very interesting work is not, in our judgment, so good as the one we noticed in a former Number. Nearly the whole of it is devoted to astronomy; and the popular treatment of that subject presents no ordinary difficulty after the work of Sir John Herschell. An account of the various kinds of pendulums, which we observed in our former notice had been left out, is here introduced. We shall give a few extracts from that part of the work which treats of Horology, to enable our readers to judge of its quality.

"Various instruments were contrived, therefore, for this purpose; and some of them showed great ingenuity. The common hour-glass, in which the interval is measured by the passage of fine sand through a small hole, seems to have been one of the earliest of these. It cannot, however, be at all depended upon for accuracy; since a difference of two or three minutes not unfrequently occurs in the times required by the sand to run through; and its passage may be very much hastened by frequently shaking the glass, so as to keep the surface of the sand constantly flat. The most satisfactory of the ancient instruments for the measurement of time, was the *Clepsydra* or water-clock; in which the hours were indicated by marks upon the side of a vessel filled with water, from whose bottom a small stream was allowed to flow out. As the water in the vessel ran off, its surface sank; and its height, as shown by the marks, indicated the time that had elapsed. It was soon found, that the water does not run from such an orifice with a regular velocity; for, when the vessel is full, the pressure of the fluid is much greater than when it is nearly empty, and its flow will be proportionally faster. But by making the divisions on the side long or short, according to the rapidity of the flow, the hours might be equally divided. Various additions were made to these clepsydræ; especially by Ctesebius of Alexandria, who flourished more than 200 years before Christ. Thus the water was made to carry a float, which sank with it; and a string attached to this float, and carried round a wheel to which a hand or index was attached, caused this to revolve, and thus to point out the hours on a divided dial-plate. It is related in an old chronicle, that the Emperor Charlemagne received, as a present, from the celebrated Sultan Haroun al Raschid, in the year 809, a curious clock, which struck the hours by means of little balls of metal let fall upon a bell, and in which figures of horsemen, at the hour of twelve, came forth through little doors and returned again. This is known to have been a clepsydra, or water-clock."

The use of the clepsydra was, it would appear, unknown to our ancestors in the time of Alfred; for that prince employed candles for the measurement of time, and he invented the horn lantern to burn his candles in, so that they might be unaffected by draughts of air. After giving an account of the mercurial and gridiron pendulums, and other pendulums and balances of various kinds, Dr. Carpenter proceeds to explain how these modes of compensating for expansion are made available in the construction of chronometers. We give the following:—

"*Chronometers.*—These are the principles on which the excellence of a time-keeper depends. In their application to practice, however, every thing depends on the perfection with which the machine is constructed; and the minuteness of the conditions required for the good going of a chronometer may be judged of from the fact, with which practical men are familiar,—that, of two chronometers, constructed upon the same plan, and finished with equal care in all respects by the same hand, one may go very well, and the other comparatively badly, without any discoverable difference between them. In finally adjusting a chronometer, no attempt is made to keep it exactly to *mean time;* that is, to make it continue to point, day after day, and week after week, exactly to the correct hour; for it is just as advantageous to allow it to gain or to lose a few seconds a day, provided that the gain or loss be *regular* in its amount; since the real time may be known with equal accuracy from that which the chronometer indicates. Thus, suppose that I have a chronometer which was set 36 days ago, since which time it has been gaining 5 seconds a day; if its gain have been regular, its whole gain during that period will be (5 × 36) 180 seconds, or three minutes; and three minutes being deducted from the time to which the hands point, we shall have the real time. This regular amount of gain or loss is called the *rate* of a chronometer; and it is thus expressed:—When the chronometer is said to have a rate of + 2·53, we understand that it is gaining 2½ seconds per day; but if its rate is — 3·2 we know that it is losing 3⅕ seconds per day. The more closely it keeps to this rate, the better the instrument will obviously be; but if it vary much from its rate, even though its errors should be sometimes on one side, and sometimes on the other, so as to compensate one another, and make the general average the same, the performance is bad, and cannot be relied on.

"When the minuteness of the parts of a chronometer is considered, and the variety of disturbances to which it is exposed, the accurate performance to which it may be brought is most wonderful. For it must be remembered how very trifling a cause, if constantly acting (such as a slight thickening of the oil,) will greatly alter the result. Thus, as there are 1440 minutes in a day, any cause which makes each vibration of the balance (of which there are five in a common watch) take place in 1-7200th part less or more than its usual time, will cause the time-keeper to gain or lose a minute a day. And as there are 86,400 seconds a day, any cause which makes each vibration of the balance of a chronometer (which usually occurs 4 times in a second) take place in 1-432,000th part less or more than its usual time, will cause it to gain or lose a second a day—an error of very considerable magnitude. When it was first supposed that chronometers could be made sufficiently perfect to give important assistance in the determination of the longitude at sea, (the mode of doing which will be explained hereafter), a parliamentary reward of 10,000*l.* was offered in 1714 to any one who should construct a time-keeper capable of doing so within the limit of sixty geographical miles, and 15,000*l.*, if to forty miles; and 20,000*l.*, if to thirty miles. Now a chronometer that has so much changed its rate as to have gained or lost, in a few weeks, two minutes more than it was estimated to have done, would gain the highest of these rewards; so that the utmost degree of accuracy which was contemplated as possible, at the beginning of the last century, when this act was passed, is far surpassed at present.

"The reward was gained by John Harrison, who, in 1736, completed the first chronometer used at sea, after many years of patient study and laborious experiment. He gradually improved his machine; and in 1761, the first trial was made of it, according to the regulations of the Act of Parliament, by a voyage to Jamaica. In consideration of his advancing years, his son was allowed to take this voyage instead of himself. After eighteen days' navigation, the vessel was supposed by the captain to be 13° 50′ west of Portsmouth; but the watch giving 15° 19′ or a degree and a half more, was condemned as useless. Harrison maintained, however, that if Portland Island were correctly marked on the chart, it would be seen on the following day; and in this he persisted so strongly, that the captain was induced to continue in the same course, and accordingly the island was discovered the next day at seven o'clock. This raised Harrison and his watch in the estimation of the crew, and their confidence was increased, by his correctly predicting the several islands as they were passed in the voyage to Jamaica. When he arrived at Port Royal, after a voyage of 81 days, the chronometer was found to be about 5 seconds too slow; and, finally, on his return to Portsmouth, after a voyage of five months, it had kept time within about one minute and five seconds, which gives an error of about 18 miles. This amount was much within the limits prescribed by the Act; but Harrison did not receive the whole reward until a second voyage had been made; and large as the sum appears, it cannot be regarded as more than equivalent to the devotion of extraordinary talents, with unwearied perseverance, during 40 years, to the attainment of an object whose importance can scarcely be estimated too highly."

A Course of Practical Geometry for Mechanics, as introductory to every Branch of Mathematical Drawing. By W. Pease. London. Simpkin, Marshall, and Co. 1843.

We are not favourable to the plan upon which most of the works intended for the use of mechanics are written, because they in general are nothing more than an assemblage of rules, many of which are quite empirical; and the remainder, being unaccompanied by any solution or proof, escape the memory as soon as the book is closed. We think, however, that the study of the elements of geometry would be greatly facilitated were the student previously expert in drawing geometrical figures, as, from an acquaintance with the proper method of their construction, many difficulties in the proof would vanish. In the little work before us are plain directions for acquiring this expertness, illustrated by a great variety of examples, which, besides being useful in themselves, will, from the manner in which the solutions are given, be of great assistance when the proofs are studied. We can recommend the work to artizans as well worth eighteen-pence; and we think that, in the hands of youth, it will be found a good precursor to Euclid.

Plain Hints for understanding the Genealogy and Armorial Bearings of the Sovereigns of England; with a Description of the different Styles of British Architecture. By A. Barrington, M.D. London. Varty. 1843.

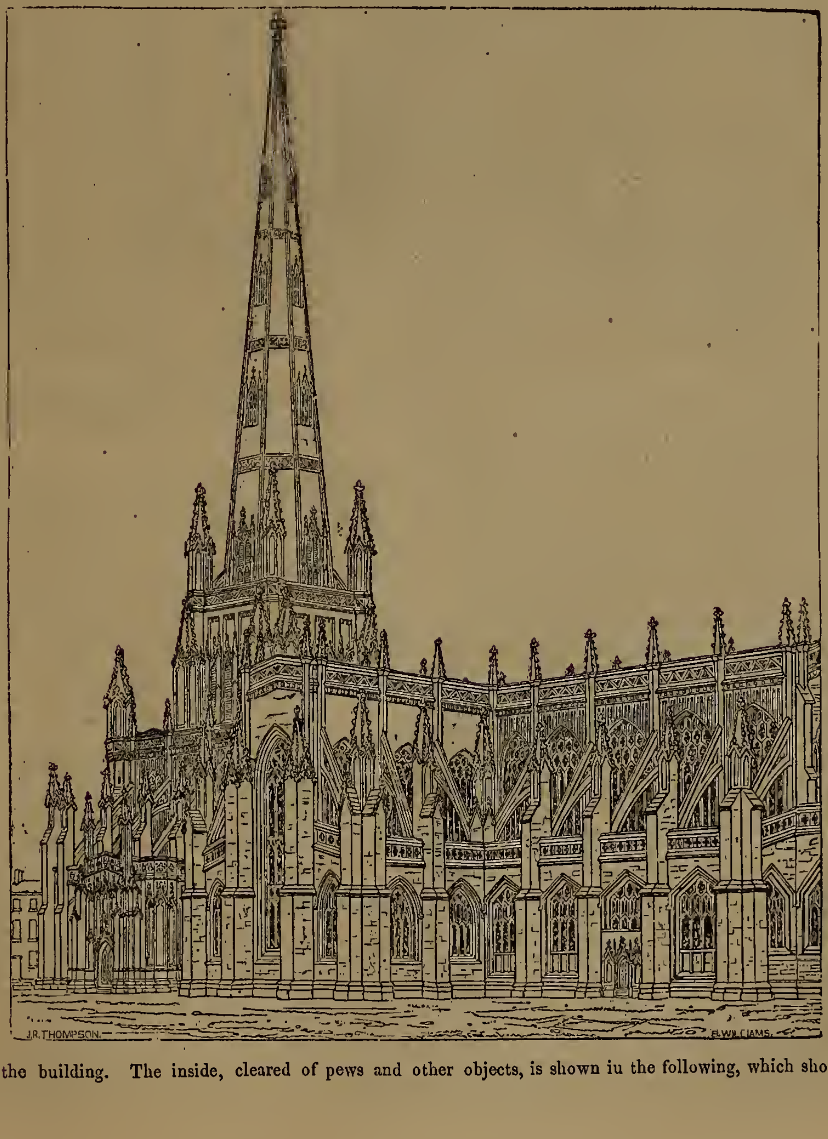
This little work, which is formed after the manner of question and answer, is intended to constitute the accompanying text to a valuable Chronological chart lately published, and which we noticed in a former Number. Upon this chart specimens of the architectural styles are depicted which were prevalent in different eras.

The work before us contains a large fund of interesting information; is clearly and unostentatiously written; and is excellently calculated to fulfil the purpose for which it was intended—that of instructing our youth in the history of their country.

Restoration of the Church of St. Mary, Redcliffe, Bristol. Bristol. 1842.

The church of St. Mary's, Bristol, has long been in a state of progressive dilapidation, and heavy repairs have been perpetually necessary to prevent it from sinking into ruin at once. Latterly its condition has become so alarming, that it became obvious, unless some vigorous step were speedily taken, this fine legacy of the skill and piety of our fathers would be lost to future generations; and the parish authorities thereupon determined to take such steps as might induce the wealthy of the land to come forward and avert such a calamity. They have called upon Messrs. Britton and Hoskin to furnish them with a report of the present condition of the building, and of the expense of a complete restoration. The expense is estimated at about 40,000*l*. The beauty of the restored edifice may be judged of from the annexed engravings.

ST. MARY, BRISTOL.


J.R. THOMPSON.
R.WILLIAMS.

This is the outside of the building. The inside, cleared of pews and other objects, is shown in the following, which shows the nave, &c., restored.]

The following remarks by Mr. Britton, touching the architectural styles and dates of the several portions of this edifice are of interest.

"There are four palpable varieties of Christian architecture in Redcliffe Church, manifesting as many architects, and as many different times when they were respectively designed and erected. The inner north porch, or vestibule,—the tower and spire,—the outer north porch,—the body of the church, with the Lady Chapel, and the south porch,—we feel assured were built successively; and it is generally admitted, that an older church was removed to give place to the present nave and chancel with their aisles and the transept. The oldest of these members, *i. e.* the vestibule, is of a date between A. D. 1200 and 1230. 'In 1207 Lord Robert de Berkeley granted to Redcliffe Church, at the request of William, the chaplain, his fountain of water from Huge Well, for the friars of St. John the Baptist in Redcliffe.' Lands were conferred on the same church, about that time, plainly showing that there was one then in the parish. The tower and spire we may safely refer to the reign of Edward I., as corresponding with known specimens of that age. According to the Chronicles of Bristol, Simon de Bourton, who was mayor in 1293, 'began to build the church of St. Mary de Redcliffe, when John Lamyngton was chaplain.'—(Evans's 'Chronological Outline.') Seyer, in his 'Memoirs of Bristol,' (vol. ii. p. 77,) from MS. Calendar, more cautious and particular, says, 'It was about the year 1293 or 1294 that Simon de Bourton, a person of wealth and consequence, who was mayor of Bristol in that year, and bore the same office six times, built the Church of St. Mary Redcliffe, where the eastern end now is.' Here we find it positively stated by one writer, that the church *was built*, and by another that it *was begun*, at the above date. To us it is quite clear that no part of the present *church* is so early as 1294. That the greater portion of it is to be ascribed to *William Canynges, Junr.*, may be safely inferred by the testimony of written documents, and the architectural features of the building. He was a religious, a wealthy, and a charitable merchant; and after amassing large riches, marrying, and having two children, and becoming a widower, in 1460 or 1466, he retired from business and the civil and civic pursuits of life, to become priest of the religious house at Westbury-upon-Trim, founded by his confessor and early friend, John Carpenter, Bishop of Worcester. To this association, to the influence of the Catholic hierarchy, and to the general fashion of the age, we may refer the size and style of the church, whose restoration we strenuously advocate. That other persons contributed towards the same building there can scarcely be a doubt; indeed the armorial bearings and devices on many of the bosses of the ceiling plainly show that the Staffords, Berkeleys, Beauchamps, Montacutes and others aided in this sacred and propitiatory work."

Photographic Manipulation; containing simple and practical Details of the most improved Processes of Photogenic Drawing, the Daguerreotype and Calotype. London. E. Palmer. 1843.

This little work is made up of directions for taking photographic pictures. In the Daguerreotype process the following are the different steps.—

1. Cleaning the silvered plate.
2. Rendering its surface sensitive to light, by exposing it to the vapour of iodine, bromine, or their combinations with chlorine, &c.
3. Exposing the prepared sensitive plate to the focus of either a refracting or reflecting camera.
4. Bringing out the picture by exposing it to the vapour of mercury.
5. Setting the picture, by removing the sensitive surface of the plate which has not been acted upon by the light.

It had been for some time a great objection to the Daguerreotype pictures, that they were so easily rubbed out, and various plans had been devised to remedy the evil. None, however, can be said to have been completely successful before the trials of M. Fizeau, who has completely succeeded in effecting the object. This fixing process is thus described by M. Fizeau:—

"Dissolve sixteen grains of chloride of gold and thirty-seven grains of hyposulphite of soda, each in two pints of distilled water; pour the solution of gold into that of the soda, a little by little, agitating between each addition. The mixture, at first slightly yellow, becomes afterwards perfectly limpid. This liquid now contains a double hyposulphite of soda and gold.

"To use this salt of gold, the surface of the plate should be perfectly free from any foreign substance, especially dust; consequently it ought to be washed with some precautions, which might be neglected if it was to be finished by the ordinary mode of washing.

"The following manner generally succeeds the best:—The plate being yet iodized, and perfectly free from grease on its two surfaces and sides, should have some drops of alcohol poured on the iodized surface; when the alcohol has wetted all the surface, plunge the plate into a basin of water, and after that into a solution of hyposulphite of soda.

"This solution ought to be changed for each experiment, and to consist of about one part of the salt to fifteen of water: the rest of the washing is done in the ordinary way, only taking care that the water should be as free as possible from dust.

"The use of the alcohol* is simply to make the water adhere perfectly all over the surface of the plate, and prevent it from quitting the sides at each separate immersion, which would infallibly produce stains.

"When a picture has been washed with these precautions, the treatment with the salt of gold is very simple. It is sufficient to place the plate on a support, and pour upon its surface a sufficient quantity of the salt of gold, that it may be entirely covered, and heat it with a strong spirit-lamp; the picture will be seen to brighten, and become in a minute or two of great force. When this effect is produced, the liquid should be poured off, and the plate washed and dried.

"In this operation the silver is dissolved, and the gold precipitated upon the silver and mercury, but with very different results; in effect, the silver, which, by its reflection, forms the shades of the picture, is some way darkened by the thin film of gold which covers it, from which results a strengthening on all the darks. The mercury, on the contrary, which, in the state of an infinite number of small globules, forms the lights, is augmented in its solidity and brightness by its union with the gold; from which results a great degree of permanency, and a remarkable increase in the lights of the picture."

United Service Journal, No. 174, May. Colburn. 1843.

THIS, upon the whole, is a tolerably good number. There is little in it, however, to interest the mechanical reader; a circumstance to which much of its goodness is probably due: for science, either practical or abstract, is certainly not the *forte* of this periodical. The first article, on the Hurricanes of the Atlantic, disagrees with Colonel Reid's 'Theory of the Law of Storms,' to which it subscribes. Of this theory we must endeavour to give some idea to those of our readers who may happen to be unacquainted with it.

Colonel Reid maintains, then, that storms do not consist of great streams of air moving on in a rectilinear direction, but of great revolving currents which sweep round a vertical or somewhat inclined axis. Every storm, in fact, according to this theory, is a whirlwind, and rushes from left to right—the axis of rotation at the same time advancing or receding with a varying speed. These great aerial columns are of different sizes, the smallest being the tornado; and their limit sometimes constitutes not a circle but an ellipse, owing to the influence of local disturbing forces. All this seems to be well established by experience—the results of which are embodied in the following dicta:—

"I. The storms of the greatest severity often originate in the tropical latitudes, and not unfrequently to the northward or eastward of the West India Islands, in which region they are distinguished by the name of hurricanes.

"II. These storms cover at the same moment of time an extent of contiguous surface, the diameter of which may vary, in different storms, from 100 to 500 miles, and in some cases they have been much more extensive. They act with diminished violence towards the exterior, and with increased energy towards the interior of the space which they occupy.

"III. While in the tropical latitudes, or south of the parallel of 30°, these storms pursue their course, or are *drifted* towards the west, on a tract which inclines gradually to the northward till it approaches the latitude of 30°. In the vicinity of this parallel their course is changed somewhat abruptly to the northward and eastward, and the track continues to incline gradually to the east, towards which point, after leaving the lower latitudes, they are found to progress with an accelerated velocity.

"IV. The rate at which these storms are found thus to advance on their course varies much in different cases, but may be estimated at from twelve to thirty miles an hour. The extent to which their course is finally pursued remains unknown; but it is probable that, as they proceed, they become gradually extended in their dimensions, and weakened in their action, till they cease to command any peculiar notice.

"V. The duration of the storm at any place within its track depends upon its extent and the rate of velocity at which it moves, as these circumstances are found to determine the time which is required for the storm to pass over any given locality falling within its route. Storms of smaller extent or dimensions are usually found to move from one place to another with greater rapidity than larger storms.

"VI. The direction and strength of the wind exhibited by a storm over the greater portion of its track is found not to be in the direction of its progress; the rate or velocity of which progress would be insufficient to produce any violent effect. In the lower latitudes the direction of the wind at the commencement is from a *northern* quarter; and during the latter part of the gale it blows from a *southern* quarter of the horizon. After reaching the more northern latitudes, and while pursuing their course to the northward and eastward, these storms commence with the wind from an eastern or southern quarter, and terminate with the wind from a western quarter."

It has been objected to Colonel Reid's theory, that it explains effects without a cause; for it nowhere very clearly appears in what way the rotation of the aerial column has been begun. The ordinary theory supposes that rarefaction is produced by the action of the sun, and that air rushes in to restore the equilibrium; which rush of air constitutes the storm. Colonel Reid, however, has made no little progress, if he has shown that the movement of the air in a great circle is the fact; and we certainly think he has done this. It appears to us, moreover, that this circular motion of the air may be traced at once to rarefaction, the air being put into motion by the upward current, on the same principle that a vortex is created in a vessel of water by making a hole in the bottom. At the same time we think every theory is a piece of quackery which attributes every phenomenon of every atmospheric commotion to a single cause. Rarefaction is, no doubt, one powerful agent; but there are many others more or less connected with the final event. Electricity, magnetism, and other agencies, have, no doubt, to do with storms as they have with almost everything else.

There is too much in this number, we think, of foreign places and adventurers, and too little of solid practical matter, which might have some better effect than pampering the appetite for excitement. Nevertheless, we would rather have a succession of light and frivolous stories, than the absurd philosophy of empty and arrogant prosers. The following little extract, from the letter of a correspondent, relative to dry rot, is good; it presents a singular conformity with the views advanced on the same subject in our first number.

"If wood-work in a damp part of a building is painted on the outside, it will inevitably decay in a comparatively short period, the substance of the wood completely perishing. Instances of this are continually to be found in churches, where damp is necessarily more liable to accumulate in the walls than in houses. The *cause* of this decay is, that the moisture, having penetrated the wood from the wall or ground, is prevented from escaping by the paint on the surface, and consequently speedily destroys the wood. I can adduce, and could show in the village whence I write, a remarkable example how much longer wood in a damp situation will last *unpainted* than painted. The stairs of a cottage, wherein I resided for a short period, were painted at the sides, the centre being carpeted. The boards are elm, and the painted sides are in such a condition, that nails will not hold, while the centre is nearly or quite as sound as ever. So also in the church, the wooden lining of the pews against the wall, merely covered with baize, has lasted longer than other wood-work, in *a less damp situation*, which has always been painted. And I believe examination will show this to be the case *generally*."

Dublin University Magazine for May. Dublin. W. Curry, jun., and Co. 1843.

THIS work is a powerful rival to Blackwood, both in talent and intolerance. The article in the present number that we like best, is the review of the Works of the Rev. Sydney Smith. We altogether dissent from the writer's conclusions, but much admire the talent with which he unfolds them. We have long regarded the Rev. Sydney Smith as one of the best and ablest men of the present time; and this opinion is quite unshaken by the forcible attacks of this ingenious Reviewer. We could say much to justify our opinion, if this were the place and time for such a dissertation.

The article on 'Three Thousand Pound Notes' is bad. There is an article of considerable length on 'Ecclesiastical Architecture,' from which we shall give some extracts. We concur in the opinions of the writer to a considerable extent.

"At a period when the doctrine and discipline of the ancient church occupy so much of attention, it is but natural that the long-lost interest respecting ecclesiastical architecture should contemporaneously revive. Here, at least, was a point in which no one could pretend to deny that we might profitably learn from our forefathers. Architectural societies have accordingly been instituted at Oxford and Cambridge, (why does not Dublin follow the example of her sisters?) which we trust will be the means of diffusing throughout the country a juster feeling and a correcter taste respecting our ecclesiastical buildings. We may trust that *for the future*, at least, no such odious barbarisms will be tolerated, as offend the eye in so many of our modern and *modernized* churches. We shall have no battlemented roofs of stone and lead, replaced, *as more ornamental*, by slates and tiles. We shall have no whitewashing of ancient oak—no plastering of stone pillars—no pulpits erected in the east window behind the communion-table. We shall never see one more specimen of the half-barn half-church which Lord Morpeth desired as the model of our future parish churches, and whose cost his lordship estimated at 100*l.* per church.

"There is scarcely any thing good that cannot be perverted. It is vain, therefore, to expect that this revival of architectural taste may not, in some cases, lead individuals to form exaggerated and erroneous opinions. An enthusiastic and poetic admirer of church architecture will feel some difficulty in enduring a gigantic room with white-washed walls, and square windows, and a couple of deal boxes perched on either side of the communion-table. If, however, he be a man of common sense, he will feel thankful that such structures should be raised where thousands and tens of thousands of our population are without the means of spiritual instruction, and where funds could not, by any possibility, be raised on a more extensive scale. We heartily concur with the Bishop of Chester in reprobating such mawkish architectural sentimentality as would mourn over such edifices, without any feeling of allowance for the circumstances which had rendered them necessary. It is, indeed, melancholy that any individual should be found absurd enough to sneer at the exertions of those who are providing church accommodation, even of the rudest sort, for the masses of Manchester or Birmingham, because, forsooth, they are unable to build cathedral-like edifices with

'Turrets, spires,
And windows climbing high, from base to roof,
In wide and radiant rows.'

"Little danger need, however, be apprehended from such an extreme of architectural romance. It is too extravagant ever to become popular. When no other churches *can be* erected, no sensible man will ever object to the very plainest and most unornamented that can be composed of wood and stone. But while we freely admit, and thankfully admit, 'that pure and holy thoughts may arise, and fervent prayers may be uttered alike under raftered roofs as in vaulted aisles,' yet we are equally convinced that devotion would be heightened, nay, oftentimes be produced, if greater attention were paid to holy places and holy things. 'Manifest it is,' says the profound Hooker, 'that the very majesty and holiness of the place where God is worshipped hath *in regard of us*, great virtue, force, and efficacy, for that it serveth as a sensible help to stir up devotion, and *in that respect*, no doubt, bettereth even our holiest and best actions in this kind. As, therefore, we everywhere exhort all men to worship God, even so, for performance of this service by the people of God assembled, we think not any place so good as the church, neither any exhortation so fit as that of David—'O worship the Lord in the beauty of holiness.'"

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* The alcohol used should be the strongest that can be procured; the ordinary alcohol being very liable to produce stains.

The following is exactly representative of our ideas, except that it is a flattered likeness.

"While man's nature remains what it is, it is preposterous to suppose that our religious feelings will not be powerfully affected by external circumstances. Our senses are part of that compound being which was formed in the image of God; and they were created to be consecrated to his service. It is as much an error to abstract our religion altogether from every thing sensible, as to place it altogether in external things. The Christian philosopher, as was said of the most practical of Grecian dramatists, addresses himself to man as he is in fact. Music, architecture, sculpture, should be employed not so as to absorb the mind, but just sufficiently to raise and sublimate devotion. Nor would it be easy to form a conjecture how deeply, perhaps irretrievably, the Church of England has suffered from the modern disregard of these adjuments of religion. Sir Samuel Romilly describes the French chapel which he frequented when young, as a 'large uncouth room, presenting to the view only irregular unpainted pews, and dusty plastered walls.' The manner in which the service was performed was equally unattractive. 'Nothing,' he adds, 'was ever worse calculated to inspire the mind of a child with respect for religion than such a kind of religious worship.' It is in childhood that our most lasting as well as our most vivid impressions are formed. And what must be the effect on the susceptible minds of those children who first become acquainted with our public services in such cold, damp, dreary, miserable edifices, as constitute too large a proportion of our country churches? How hard for them to experience that cheerfulness and joy which social worship is so calculated to enkindle, when the spirit of our noble liturgy is fitly imaged in the beauty and the dignity of the outward temple. 'While man is man,' remarks the elegant Bishop Horne, 'religion, like man, must have a body and soul; it must be external as well as internal; and the two parts, in both cases, will ever have a mutual influence upon each other. The senses and the imagination must have a considerable share in public worship; and devotion will accordingly be depressed or heightened by the mean, sordid, and dispiriting, or the fair, splendid, and cheerful appearance of the objects around us.'"

The truth of these views is fully borne out by experience. There is no one who has not felt that the heart may be melted, or the spirit smitten with awe, by impressions which reach us through the senses; and in these impressions piety very often begins. The true danger lies not in the use of decoration or ceremonial, but by specifying with over-minuteness what the decoration or ceremonial shall be. Handsome churches, fine paintings, and fine music, we should like to see universally prevailing; but all these things would be dearly purchased, if so introduced that vulgar minds might be brought to conceive there was something mystical and weighty in their most petty details. Such a belief would put us back into the grovelling superstitions of the dark ages. The Dublin University should look to these things: people now turn their eyes to it as an antidote to Oxford. Church architecture should be encouraged, but we think it should be in a new style.

The Nautical Magazine, No. 5, for May, 1843. Simpkin, Marshall, and Co.

THIS periodical we look upon as being one of much value, chiefly from the facilities it seems to possess for obtaining admiralty statistics. The work, however, is too geographical for the taste of most readers, and would be much improved, we think, by a greater variety.

There is an interesting letter from Sir John Ross, in the present number, relative to a project which had been agitated of forming a chart of the currents in our channels and seas, by throwing a number of bottles overboard, the drifting of which might indicate, not merely the direction of the current, but also its force. Sir John Ross says, that the project is a delusion, inasmuch, as by experiment he has found bottles cast adrift in the manner proposed, to be much more influenced in their progress by the wind than the tide. By loading the bottles, however, so that they barely float, and leave no projection above the water to be acted on by the wind, this objection appears to be done away.

Many of our readers are, no doubt, aware of certain inventions of Mr. Clement, for ascertaining the speed of vessels, and other particulars of their performance of importance to navigation, having been tried in the French navy and found to answer well. The nature of these inventions will be made apparent, by the following:—

1st. The *Sillomêtre*, as its name denotes, is an instrument to measure the rate of a ship's sailing, which is shown by a dial on deck, and is intended as a substitute for the common log.

2nd. The *Sub-Marine Thermometer* is a very delicate thermometer composed of platina and silver, placed at a depth of about ten feet below the surface of the water, and communicating with a dial on deck.

3rd. The *Steam Thermometer* points out the temperature, and consequent pressure of the steam in the boilers, which is also shown by a dial on deck.

4th. The *Derivomêtre* is an instrument somewhat on the principle of the sillometre, and intended to measure the drift of a ship.

5th. The *External and Internal Thermometer*, as its name indicates, is a highly sensible thermometer, so placed against the wall of an observatory, or house, as to show the temperature of the air without and within: the two pointers which mark this are on the face of the same dial.

These instruments have, it appears, been recently fitted to Her Majesty's Ships "Lightning" and "Blazer," with a satisfactory result, as the report says. In our eyes, however, the whole of the instruments, with the exception perhaps of the marine thermometer, are useless refinements, and are not so good as the instruments for arriving at the same results previously in use. In what respect, for example, is the steam thermometer superior to the steam gauge? The fact is, it is not at all equal to it in accuracy, and is certainly not so fit an instrument for engineers to handle. The purpose of this thermometer is to show by the temperature the pressure of the steam, but this, in a sea-going steamer, *it will not do*, inasmuch as the temperature is influenced not by the pressure of steam alone, but also by the saltness of the water in the boiler. The Sillomêtre is not equal to Massey's log; it involves the necessity of observation, and is, therefore, open to the objection of trouble, and of probable error, which are obviated by Massey's contrivance. The last two instruments have not, we believe, been yet tried in our navy—probably, from the conviction that they were merely ingenious playthings.

The only other point of interest we can see in this number is, the suggestion by a correspondent, that the loss of the "Conqueror," "Reliance," and other vessels on the coast of France, may have been occasioned by a deflection of the compass, caused by the agency of lightning. This appears to us a highly probable conjecture; the sudden and powerful effects exercised upon the needle by thunderstorms, hurricanes, and other atmospheric phenomena; attended by electric action, have been made manifest by repeated observation. At the same time, there is a sort of danger in admitting any potentiality to attach to such agencies in common cases, as then every captain who lost his ship would lay the blame upon a squall.

The Athenæum. Nos. 809, 810, 811, 812.

No. 811 contains the concluding Lecture of the series of lectures on painting delivered by Professor Howard before the Royal Academy. The same Number contains the notice of a project of establishing free exhibitions of objects illustrative of Fine Arts, Natural History, Experimental Philosophy, Machinery, Manufactures, &c. One of these exhibitions is now preparing at Liverpool, and another is about to be opened at Derby. No. 812 contains a very important paper, by Horatio Prater, intended to prove that the effect observed by Möser to be produced on polished metallic surfaces, by the juxtaposition of other bodies, is not due either to heat or light. We give such extracts from this paper as our limits permit.

It is proposed now to demonstrate, that the radiation discovered by Möser is not invisible light, as he supposes, nor heat, as has since been supposed. For, first, where is the evidence that bodies absorb light? Some few, certainly, have been shown so to do; but surely not the metals, &c. &c. which exhibit the greatest facility in receiving and giving the impressions discovered by Möser. It seems, *à priori*, more probable that the radiation in question should consist of heat (which we know exists in all matter) than of light. Accordingly, Mr. Hunt has written an elaborate paper in favour of the supposition that such radiation consists of heat. In the course of this essay, however, it will appear, that neither of these suppositions is correct.

1. *With regard to the nature of the substances that produce spectra.*—Every substance I have tried has produced its spectrum when left on a polished copper plate. Coins, whether of gold, silver, or copper, platinum, nickel, brass, pieces of glass, wafers (red, blue, and white,) peppermint or rose drops, whalebone, talc, gum, a horse-hair ring, lava from Vesuvius, Indian rubber (but slight,) and sealing-wax. This last, left ten days, gave a whitish grey *permanent* spectrum, clearer than any of the others, though the wax and plate were both kept dry as usual. The impression on a small brass seal (a P) was very obvious when the plate was breathed on. The seal had been left ten days.

2. *Effect of dissimilar metals.*—It has been asserted, that when a gold or silver coin is placed on a copper plate, the effect is greater than when a copper coin, &c. is placed on the same metal. When heat is used, this position is true, as will be shown hereafter; but when the plates and coins are both kept cold, (exposed to external air, for instance, in March,) a farthing, on two different occasions, in an hour, left as good a spectral image as a sovereign,—I thought, a better one.

It was, however, remarkable, when a heat of 160° was applied to this plate, that the spectrum of the copper soon became invisible, while that of the gold was apparently not at all diminished. This experiment was repeated twice with the same result. I likewise found that, though the spectrum of the copper was to appearance, *at first*, as good as that of gold or silver, yet that it began to disappear much sooner, after a few breathings on the plate, than did the spectrum produced by gold or silver. *On the whole*, therefore, it seems right to admit that the effect is greater when dissimilar metals are used.

3. *Effect of unequal heat on the plate and coins.*—It has also been asserted that when the copper coin is heated, and the metal plate of copper kept very cool, that the effect is increased. I have, however, not been able to satisfy myself of the truth of this statement. A penny and a farthing, heated to between 130° and 160°, and laid on a cold copper plate half an hour, did not appear to leave even so good a spectrum as two of the same coins left to cool for half an hour outside the window, by the side of the plate itself, before being placed on the plate. All the coins were placed on the plate at the same time, and left the same time. Neither could I perceive any difference when one sovereign was heated and the other not, both being placed on the same copper plate.

4. *Effect of heat generally.*—In order to ascertain whether heat hastens the impression, the following experiments were made:—1. A bright half-sovereign, a bright halfpenny, and a dull one, were heated to about 150° on a polished copper plate. The half-sovereign left a *permanent* impression; and both the halfpence left spectra visible only by breathing. It was obvious from this experiment and others, that heat increases the effect where *contact is permitted*, since the impression is permanent. Accordingly it was deemed right to try if heat has this effect when the coin is at a distance from the copper plate.

I put a silver fourpenny piece on the plate, and on the fourpenny piece I put a penny. I found that when these remained only twenty-four hours, that no spectral image of the penny was produced; but on remaining forty-eight hours one was apparent. In this last case, the lettering of the fourpenny piece became almost visible when breathed upon, but not being breathed upon, no mark of it at all was perceptible. The penny piece, however, left its mark without being breathed upon—an annular *bright* mark, which was not rendered more or less distinct by being breathed on. The spectrum of the fourpenny piece was alone brought into view by this. The place where this had lain was exactly as bright as that covered by the penny. In fact, the copper plate seemed preserved from oxidation by the contact and proximity of these coins. Thus, then, it appeared to require forty-eight hours for a spectrum of the penny piece to be produced—the spectrum of a coin *not in contact.* The same experiment being made at a heat of 160°, no spectrum of the penny appeared after one hour, though the fourpenny piece had left a strong impression.

Ditto, continued for five hours, a spectrum of the penny was *just* visible, and only so when the plate was held in a particular position with regard to light.

A half-crown piece being laid on a half-sovereign, and the same heat continued five hours on the same plate, the half-sovereign left a still better impression than the fourpenny piece above mentioned, and the half-crown had also made a *permanent* spectrum very visible.

A farthing, which had rested the same time *on* the plate, left no permanent spectrum, but only one slightly visible by breathing. Even when pressed upon by two pence, and left eight hours, it left only a *barely visible* permanent spectrum: so a brass medal. These spectra being rendered far more visible by breathing, could hardly be considered permanent spectra.

These experiments show:—1st. That heat much increases the rapidity of the radiation, *even when the object is not in direct contact;* and, 2ndly. That it takes place much more energetically from gold and silver than from copper (a copper plate being used.) They also show that a permanent spectrum is to be considered only as a *higher degree* of that produced or rendered apparent by breathing.

A sovereign, two hours *on* a very thin lamina of talc, at the above heat, gave no spectrum; talc alone gave its spectrum; nor did a halfpenny, eight hours on the same at the same heat; nor a shilling (new) on a thin piece of glass, the shilling being under a halfpenny. The talc and glass in these cases alone gave a spectrum; the talc a better and more permanent one than the glass. I should have said the talc was on copper-plate.

The spectrum of the penny, in the experiment lately detailed, is equally visible when the experiment is made on glass; but polished metals seem to show it the best.

When glass is used, there is, after from twenty-four to forty-eight hours, a slight deposition of dust, &c. around the parts which are not covered by the penny, and thus a round mark (permanent spectrum) is visible on removing the penny, even before breathing at all; still on rubbing it off *till nothing is visible*, and breathing on it again, the spectrum of the penny appears, as well as of the fourpenny piece, proving that dust adheres much more strongly than we should have supposed, or perhaps better—leaves its mark behind with greater pertinacity.

That this is the true explanation of the appearance of a spectrum, when the coin is not in direct contact with glass, was to me rendered clear by another experiment, in which a half-crown was left on one sixpence, and a penny on another, on a clean glass plate *covered over with paper, and kept in a closet* for ninety-six hours; yet on examination, neither a permanent spectrum, nor even an evanescent one by breathing, was perceptible either of the half-crown or the penny; the sixpences alone had left spectra (which, however, were only visible by breathing,) that under the half-crown being the clearest. Yet the penny and half-crown were in the best condition for giving spectra, for the surfaces of both were tarnished, and that of the copper purposely so.

This result induced me to try the same with a copper plate, and I found that when a bright half-crown (having been well boiled in water and then polished) was placed on a fourpenny piece, similarly treated, and left forty-eight hours *covered* in the closet as above, that the half-crown left no spectrum, even evanescent. Neither did a *purposely* tarnished penny placed on another fourpenny piece, and left the same time.

5. *As regards the distance from the plate at which images may be taken.*—A silver fourpenny piece is about the one-twentieth of an inch in thickness, and at this distance we have seen silver, copper, and of course gold, give a spectral image on a copper plate. But on putting a half-crown on two sixpences and a half-franc piece, making the distance from the plate more than the one-tenth of an inch, no spectrum of the half-crown was made, although the experiment was continued for twelve successive days and nights. Neither was any made by removing the half-franc piece (thus making the distance only one-tenth of an inch,) and continuing heat of 160° or so for five hours.

A sovereign fixed at three-quarters of an inch, and a small brass medal at somewhat less than half an inch, from a polished copper plate, and continued in such position for seventeen days and nights in a little closed deal box, gave not the least vestiges of spectra; neither did a fourpenny piece left at one-fifth of an inch, nor a card plate (engraved) left the one-tenth of an inch, for eleven days. The copper plate had remained *perfectly polished* in both experiments; and this is worthy of remark, as showing that in *confined* air copper does not oxidate perceptibly. Another plate left in the *same* room was completely tarnished in five or six days.

A fourpenny piece, about the one-twentieth of an inch, under a silver plate for eleven days, gave scarcely a perceptible spectrum; though a farthing, on which the plate *had rested*, gave a good spectrum, but not a *permanent* one, (*i. e.* breathing was required to show it.)

A fourpenny piece is about the one-twentieth of an inch in thickness, and this seems the greatest distance an image can be taken by the above plan. But even at this distance I have not succeeded, if the half-crown laid on the fourpenny piece is *perfectly* polished, and *all external dust, &c., carefully excluded* by the box just mentioned—(see Sec. 8, on the comparative polish of metals.)

6. *As regards impressions on glass.*—We have already observed that heat does not seem to increase the effect of *metal* coins on glass. Neither did *long contact;* for a fourpenny piece, left a *week* on a piece of looking-glass, only left the usual spectrum, no *figure* being visible. The same remark applies to large *printed* letters. At least, some paper with these, after remaining pressed two or three days without giving any impression, was then heated for five hours, so pressed, at about 160°, but no impression was made. On another occasion, print and writing were left a week on a glass mirror without leaving an impression. When, however, thinner paper and larger letters were used, and heat and pressure applied as above for four or five hours, these letters were plainly visible; but, as appeared to me, far more easily erased than were the spectra of *coins* on copper plates. A slight touch of the finger, for instance, erased the letters in question. They were produced in this case in consequence, no doubt, of the thinner paper being *moister* than that first used.

Heat does not appear to increase the effect on glass. A fourpenny piece under a shilling for three hours, at 160°, left no spectrum.

On putting a penny on a sovereign, and leaving them for three hours and a half at the above heat, I thought the spectrum of the penny slightly visible; but as the image is never so apparent as on polished metal, I shall not venture a decided opinion on this point as regards glass.

A *polished, boiled,* and then well dried half-crown gave as good a spectrum on a glass plate in twenty-four hours, as did a dirty half-crown; but I thought the spectrum of the former disappeared sooner by breathing. On a far thinner glass plate, a bright, boiled fourpenny piece, left the same time, gave no spectrum at all.

7. *Polished surfaces not appearing capable of receiving the impressions.*—These exceptions from the general rule I have found to be talc; and, among the metals tried, steel to a certain extent, platinum, and gold.

Whether heated or not with the coins on it, I have found *no* spectrum produced on talc, except in one instance, where a tarnished half-sovereign had been pressed some days by a half-pound; and even here the mere margin of the coin was *barely* perceptible.

On steel, after remaining twenty-four hours, I found a *very* slight evanescent spectrum produced by a small piece of brass; and, on *one* occasion, by a half-sovereign, very much tarnished; but as heat did not appear to increase or hasten the effect, we may consider steel almost unsusceptible. The spectra just named disappeared entirely after breathing *twice;* and no *permanent* spectrum was produced, though the piece of brass above-mentioned was placed even on the top bar of a grate, and of course kept very hot, for two or three hours.

Under the head, "Thinness of the plates," experiments, showing the incapability of platinum to receive images, are mentioned.

The same remark applies to gold. I kept a shilling and a farthing, on two different occasions, for twenty-four hours, or longer, on a well polished plate of gold, yet they barely left a marginal spectrum; and this spectrum, as in the case of steel, disappeared entirely on breathing on it twice. As the gold used was not free from the usual alloy of copper, possibly this was the cause of its receiving even the very slight spectrum it did. However this be, these experiments seem almost sufficient to establish the important general principle, viz., that the less metals are oxidable by exposure to the air, the less is their susceptibility to receive spectra.

8. *As regards comparative polish in metals.*—A new sovereign, a new half-crown, and new farthing, (all well polished,) were kept on a bright copper plate, at 160° or above, on two successive occasions, for four or five hours. The gold and silver left only very slight parmanent traces of their margin, the copper left none at all; but its spectrum, when the plate was breathed on, became, I thought, even rather more evident than the spectra of the gold and silver, these being likewise breathed on. 2. A tarnished sovereign, and a tarnished half-crown, being laid on the same copper-plate, and kept at the same heat only three quarters of an hour, a permanent and far more apparent spectrum was produced than in the former case; the whole area, where the half-crown had lain, was covered with a whitish cloud, and the impression dimly sketched. 3. By selecting a halfpenny very much tarnished, and letting it remain five hours on a bright copper-plate, heated to 160° or so, and subsequently for thirty-six hours in the cool, a permanent spectrum was produced, in which all the lettering of the coin was beautifully visible; yet here was copper. But as I found this impression to go off completely at a heat far below what the impression did, at exp. 5, below, the general principle, that silver gives a stronger impression, remains. 4. A well polished new sovereign, and a tarnished sixpence, being laid on a bright silver plate for four hours, and kept at 160°, the sovereign had left no spectrum, but the sixpence had left a permanent one, in which almost all the lettering appeared, so plainly was it visible. 5. A perfectly polished half-crown was laid on a pretty well polished sixpence, and a purposely tarnished one on a purposely tarnished sixpence, and put on the same plate with the halfpenny (exp. 3 above), heated five hours, and left thirty-six hours afterwards. The lettering, &c., of each sixpence was visible, but far more of the most tarnished; and also this was the case with that of the most tarnished half-crown, as regarded its spectrum. That of the polished was scarcely visible. But the lettering of neither half-crown was visible, though they had remained so long and been heated. This experiment also shows how much the effect is strengthened by actual contact. A similar experiment was made in the closed deal box mentioned in Section 5. The copper plate was laid upon a polished and boiled fourpenny piece, and this on a half-crown similarly prepared; after ninety-six hours no spectrum whatever of the half-crown was visible, by breathing or otherwise; but the fourpenny piece, in actual contact, had left the usual spectrum. The plate had remained perfectly polished. All these experiments show that the dissimilarity of metals is not of such importance as has been conceived: they show the difference wanted to produce the effect is a difference in brightness or oxidation, *i. e.*, as far as a permanent and good impression, showing the lettering, etc., is concerned; for I find, when left on the plate an hour or so, tarnished or polished metals give equally good spectra. But in this case the spectrum is only made apparent by breathing, and of course shows nothing of the lettering, &c. However, even in this case, the spectrum of the tarnished sovereign disappeared less soon by breathing on it than did that of the polished one; so, in reality, the spectrum of the former may be said to have been the most perfect.

The same remark applies to a glass plate. (See Section 6, as regards glass, &c.)

9. *Which metal receives images fastest, copper or silver?*—My experiments lead

me to say copper, whether heat be applied or not. When the same degree of heat was applied, I found a sovereign produced a good *permanent* spectrum (impression) on a bright copper plate, although only an evanescent one (one seen only when the plate is breathed on) was produced on an equally well polished silver plate, placed at the same time at the same heat. When heat was not applied, I found the copper received an *evanescent* spectrum first.

10. *As regards the effect of interposed substances.*—As every substance tried left a spectrum, I did not much expect that the influence would permeate any lamina, even of the thinnest description. Accordingly, when a sovereign or shilling was left twenty-four or forty-eight hours on a piece of stiff, though very thin, paper, it gave no spectrum, but the mark of the paper was alone visible. The experiment was repeated, half the coin resting on the copper plate and half on the paper: and although it remained a fortnight in this position, the half only *in contact* with the plate was visible by breathing on the paper, leaving *its own* spectral image just as if no coin had rested on it at all.

The same experiment was repeated with the thinnest possible layers of talc, gum, cork, and whalebone, glass, plane and concave, with the same result. Each substance left its spectrum, the part where the coin rested on such layer not being at all distinguishable. The spectral image of the square piece of talc was perfect to the minutest outline, and left its straight mark under the sixpence equally well as at other points. These experiments render it clear that the effect is not due to latent light; for, otherwise, how could it happen that a coin does not leave a spectral image when left on *transparent* substances, glass or talc, *even a fortnight?* They also show it does not depend on heat (at least alone), for a heat of 160° soon passed through thin glass and talc, and I found it impossible to keep my finger on glass or talc so placed. Yet we have seen above that even gold left two hours on talc so heated left no spectrum, permanent or temporary. So great is the effect of interposed substances, that even a *slight tarnish* on the metal exerts a very obvious effect. One shilling was left twenty-four hours on a polished part of the plate, and another on a part of the same slightly tarnished (but yet sufficiently bright to see oneself perfectly). A very slight image only was left in the last case, that entirely disappeared when breathed on twice, while that on the polished part of the plate remained, after being breathed on twelve or fourteen times.

A sovereign left twenty-four hours or above, tarnished, gave scarcely a perceptible spectrum, and a sixpence none at all. On such a surface a sovereign was left on two different occasions, under a penny, for three hours, at a heat of 160°, and barely left a permanent spectrum of its *outer* margin; while on a well polished surface, at same heat, the outline of the impression also would have been left as a permanent spectrum in an hour or two.

Art. XVI.—MARVELS OF THE DAY.

THE SOCIETIES.

Society of Arts.—On the 17th inst. a paper was read by the secretary on the new arrangements effected by Mr. Cooke in the electrical telegraph, and carried into execution on the Great Western Railway. Instead of placing the connecting-wires of the voltaic battery within an iron tube, and laying it in a trench, he now stretches the wires, not covered with insulating substances, on the tops of elevated standards; the parts where they bear on the supports being the only points that require to be insulated. He also avails himself of the conducting properties of the ground for the completion of the voltaic circuit; by which means, the expense of one wire is saved, and, the conduction of the return electric current being more perfect when transmitted through the ground, wires of less thickness may be used. Other advantages attending this arrangement of the wires, by which they are separate and exposed to view, are, the facility with which any defect can be detected and remedied, a more perfect insulation, and greater economy. The cost per mile of laying down the wires on the former plan was nearly 300*l.*; by the new arrangement one half that amount is stated to be sufficient.

The Geological Society.—This Society has just been entertained with one of the theories, more curious than philosophical, in which some geologists are accustomed to indulge their fancies, in attempting to account for the subsidence of the ocean after the Deluge. There is, perhaps, no subject within the range of science respecting which so many puerile absurdities have been broached. Mr. Harkness, the propounder of the new theory, accounts for the subsidence of the water by its (imagined) change of temperature. He conceives—but without any foundation for such assumption—that the temperature of the ocean before the Flood was several degrees below 40 of Fahrenheit; and as it is well known that the temperature of 40° is the *minimum* point of contraction of water, and that it expands whether heated above or cooled below 40°, any increase of heat from 32° to that point would cause the water of the ocean to contract. Mr. Harkness accounts for the increase of temperature by further imagining that a great portion of the land near the tropics was subsequently raised from the ocean, and has therefore communicated a higher temperature to the air and to the sea. It does not appear to have occurred to Mr. Harkness, that the land near the tropics could not be raised without displacing an immense body of water, and that it would consequently cause an elevation of the sea on the shores of other lands to an extent much more than equivalent to the contraction produced by the increase of temperature by the uplifted lands. No theory will satisfactorily account for the successive strata containing marine and vegetable fossils lying over one another, unless it explains by what means the same region of the globe has been submerged, and has become dry land again and again. Mr. Harkness also appears to be straining at a gnat and swallowing a camel, when he accounts so curiously for the subsidence of the ocean, and omits to account for the much greater phenomenon, the uplifting of continents.

Medico-Botanical Society.—A paper, by Dr. Cook, has been read, containing some curious and important statements relative to the poisonous properties of the *Coculus Indicus*, and its extensive use in brewing. This drug, when taken even in the minute dose of two or three grains, produces nausea, vomitings, and alarming prostration of strength; ten grains are sufficient to kill a large dog. The extent to which this virulent poison is used in brewing porter may be conceived from the statement made by Dr. Cook, that one "brewers' druggist" alone sells half a ton of it per week! Only a small portion of the quantity imported is entered at the Custom-house in its proper character, as it comes in disguised, and is frequently passed as linseed-meal. Dr. Cook is of opinion that many of the cases of sudden death among the working classes in London may be attributed to the effects of *Coculus Indicus* contained in porter; and he conceives that it is the drug employed in "hocussing." Some stricter regulations are surely required to prevent this wholesale poisoning of the people.

Astronomical Society.—This Society continues to be puzzled about the Comet which lately ventured to intrude among the stars so unceremoniously, without being announced. Opinions differ whether it be the Comet of 1668, 1702, or whether it be one previously not observed. If the former, to which opinion the majority incline, it has come at least a year before its time. Some there are who still doubt whether the late visitor has established its claim to be called a heavenly body. Another Comet, to be seen only by telescopic aid, has been discovered, and its path is being tracked. Verily, these erratic bodies give a dash of romance to astronomy, though they tend to lower it from its high position as one of the exact sciences.

French Academy of Sciences.—A new safety-lamp for coal-mines has been submitted for examination, and has been reported on. It is difficult to ascertain from the report the principle of its construction; but the materials of which it is constructed are so fragile, that it is not considered fit for general use, though capable of being advantageously employed to detect the quantity of carburetted hydrogen gas a mine may at any time contain. The name given to the apparatus is the *Gasoscope.*—The results of some curious experiments on the attractive powers of different rays of light on plants have been laid before the Academy. It appears that plants exposed to red, orange, yellow, or green light, are not attracted; but that towards the blue or violet rays of the spectrum they are very speedily inclined. These are the rays which act most powerfully as chemical agents, and are chiefly operative in producing the effects of the Daguerreotype.—Some experiments have been made by Messrs. de la Provostaye and Desains to ascertain the latent heat of melting ice. Their experiments, which have been confirmed by those of Messrs. Biot, Pouillet, and Regnault, agree in fixing the latent heat at 79° of the centigrade scale, which is equal to 174° of Fahrenheit. It would appear, therefore, that the real zero, or the point which indicates the absence of all heat, is 142° below freezing.

Institution of Civil Engineers.—May 2nd. A model of Mr. Hunt's machine for making bricks and tiles was exhibited, with several specimens of its produce. Its action was described to be, that the tempered clay is placed in a hopper, the front and back of which are formed by the peripheries of two drum-wheels covered by webs of endless cloth, which, in descending simultaneously, carry down a continuous supply of clay of the exact length and width of a brick, while a frame is projected forward at given intervals so as to determine and cut off the requisite thickness, which is received upon a pallet-board, brought forward by an endless chain. About 1200 bricks are made per hour, with the attendance of two men and three boys to attend to the machine.—A description was also given of the process, invented by Mr. Prosser, for forming tiles, tesseræ, &c., by compressing dry and finely-ground clay, by means of hydrostatic presses, into moulds, whence it was carried directly to the kiln without any preparatory drying. The specimens exhibited were very dense, and equal throughout in texture, and their edges were as sharp as if they had been chiselled. It was stated that a small hexagonal brick had withstood a pressure of 35 tons without being crushed, and that a 9-inch brick made by the same process would bear 90 tons. The process has, up to the present time, been only used for making buttons and other small articles, with the exception of some tiles or slabs for being painted on; but it was about to be extensively applied. An interesting discussion ensued on the general mode of manufacturing bricks—going back as far as the construction of the brick pyramids of Egypt, when the materials employed were aluminous sand and chopped straw. The Romans, who used finely-levigated clay, made small thin bricks of great density, and made the mortar for building a considerable length of time before it was used. The Dutch, and other foreign bricks, were also mentioned, as was the use of ashes in the making of bricks near London; and it was stated that the reason of their use was, that the material being loam rather than clay, the ashes gave it tenacity; and, at the same time, by burning slowly in the heart of the brick, a more equal amount of vitrification was obtained than could be by any other means, without pulverising such material.

May 9th. A paper was read by the Rev. Mr. Clutterbuck, on the periodical drainage and replenishment of the Chalk Basin of London. The object of the paper was to show the existence of a continuous subterranean water-level, dipping, at an average inclination, from the river Colne to the Thames below London; with reference to which, the author was enabled to determine with accuracy the height to which water would rise between those two points. A minute account was given of the nature and origin of the supply of water to that portion of the Basin which underlies the London and Plastic Clays, together with a detail of certain remarkable phenomena observable at the points at which the water finds its way into the chalk; by which it appeared that a great portion of the rain-water which flows from the surface of the clays by watercourses, sinks into the subjacent chalk on its arrival at the outcrop of the sand of the Plastic Clay formation, and thus regulates and maintains the subterranean supply for the metropolis. It was also shown that there is a depression of the natural level under London, caused by the great exhaustion of water by pumping from deep wells sunk either into the chalk or sand of the Plastic Clay formation, and that this depression is gradually increasing, and already extends two or three miles beyond the confines of the metropolis. In the discussion which ensued, the question of the probable exhaustion of the river Colne, and of the reservoir in the Chalk Basin, was strongly insisted on, if ever any considerable amount of pumping should take place in the valley near Watford for the supply of water to London; and it was shown from the register of two rain-gauges, one of them on the surface, and the other buried three feet under the ground at Nash Mills, that, of the rain which fell in two years, rather less than half reached the buried gauge; that, therefore, any calculation of a supply of water equal to that shown by ordinary rain-gauges, would be fallacious.

May 16th.—A paper by Captain Handcock was read, describing a railway axle of an improved form, invented by him. The improvement consists in making the journals with very large fillets, and one collar and fillet of each journal moveable, so that it may be tightened up to diminish the journal's length. The oscillation of the carriages is said to be thus prevented,—an allegation we do not believe. The oscillation is due to the momentum of the piston and the parts attached to it, and the diverse action of the two pistons. Six wheel carriages require to have play laterally in some of the journals, in order to enable the carriage to accommodate itself to curves.—A paper was read by Mr. F. Pellatt, upon zinc as a protecting covering for iron, and the adaptation of the process of electro-deposition for this purpose. Zinc, like most metals in commerce, is not to be met with pure: in the other metals, however, the impurities do not generally tend to the injury of the metal; but the impurities of zinc generate a galvanic current, by which the metal is rapidly destroyed. The impurities existing in ordinary zinc, and the difficulty and costliness of the process of sublimation, in order to procure *pure* zinc, were noticed. It was also strongly insisted on, that impure zinc itself being of little value, could not afford protection to any other metal upon which it might be superimposed; and that, therefore, the mode of plating iron with melted zinc (of commerce) was objectionable. The report made to the French Academy by Mons. Dumas was quoted. He says, "The zincking of iron, by steeping it in a bath of melted zinc, has many inconveniences. Besides, the iron combining with the zinc, constitutes a very brittle superficial alloy, the iron losing its tenacity." It is well known, that in the deposition of metals from metallic salts by the electro process, the pure metal alone is deposited, so that the zinc deposited is free from any injurious admixture. The iron, also, being coated with zinc in a cold solution, its internal structure is in no way changed. The expense of the process was stated to be trifling, not exceeding that of four coats of oil paint. It was stated that the patentees, Elkington and Co., Moorgate-street, have lately given an estimate for zincking the suspension-bridge at Hungerford-market.

May 23rd.—Some interesting specimens of unburnt bricks, from the pyramids of Dashoor (Egypt), were exhibited by Mr. Newton. From the description by Mr. Perring, who brought them to England, it appeared that they were made from the alluvial soil of the valley of the Nile, mixed up with chopped straw; that they were made with cavities in the sides, like the modern bricks; and that the interior of the Pyramids was formed of *arches;* the bricks composing them being either packed behind with pieces of flat pottery, or cut away, to radiate equally from the centre. There existed at Thebes some extensive ranges of arches, of about twelve feet span, the bricks of which they were built bearing the name of Sesostris; and, consequently, they must have stood uninjured upwards of 3,180 years. The arches were turned in concentric half-brick rings.—Captain Handcock produced a brass and cone of his improved axle, which had been used under an engine on the Southampton railway, and had run upwards of 21,000 miles. The brass scarcely exhibited any signs of wear; while a brass of an axle of the old form, which had only run 8,000 miles, was nearly an inch shorter than when it was first put on, besides having worn considerably into the journal and the box. He stated that the system was approved of by General Pasley, who would have been present to confirm the statement, but for an unavoidable visit to Spithead. The first part was read of a paper by Mr. Mallet, M. Inst. C.E., on the action of air and water upon cast and wrought iron and steel; but as, from its length, the second part was necessarily reserved until the next meeting, the whole will be noticed in next meeting's minutes.

The meeting was adjourned until Tuesday evening, May 30th, when the following papers will be read:—No. 620. The second part, On the durability of Iron Ships, the method of preventing their corrosion and becoming foul, by the application of a coating of alloy of zinc, of varnish, and a poisonous plant, by R. Mallet, M. Inst. C. E.—No. 584. Description of an improved Arrangement of a Surveying Instrument, by H. Carr, Grad. Inst. C. E.

INVENTIONS OF THE MONTH.

Under this head, we intend to give an analysis of the more remarkable inventions of this and other countries, which each successive month brings under the eye of the public. We do not mean to confine our notices to those inventions which have been patented, but our object will be to give our readers such intelligence respecting the progress of improvement in the useful arts as will keep them always in the van as regards information, without perplexing them with a multitude of unserviceable projects. We shall, therefore, only notice those plans which have a claim on the reader's attention, from being either more useful, more curious, or more preposterous than the rest.

New Mode of Aerial Transit.—Among the inventions which have been made known since our last publication, is a new plan of aerial navigation, which, now that Mr. Henson's project has received its *coup de grace,* may serve for a time to buoy up those who have fixed their hopes on being enabled 'to sail upon the bosom of the air.' The inventor is a German, named Schwartz, and the scene of his operations is Lyons. He has already effected more than Mr. Henson, for he has actually raised himself into the air. The success of his experiment was, however, very limited, and it holds out no promise whatever of useful practical results. The plan of this aeronaut, consists in the employment of a balloon of sufficient ascending power to sustain nearly, but not quite, the weight of his body; and by means of wings, fastened to his arms, he proposes to overcome the remaining gravitating force. The power of ascending obtained by these wings he estimates at only 14lbs., but as the weight of his body less about 2lbs. is supported by the balloon, he has ample power to raise himself from the ground. The surplus power he expects will be sufficient to enable him to guide the balloon, as well as to sustain himself at a considerable height in the air; having the advantage of lowering himself at any moment without diminishing the buoyancy of his apparatus. It is evident, however, that with only two pounds of gravitating force to offer as a resistance to the wind, the deviation to be obtained from its course must be very trifling; and the surplus power would be altogether inoperative as a means of guiding so large a body as a balloon against the wind, or of impelling it through the air in a perfect calm. It must not be forgotten, also, that even were such power obtained, the necessarily frail materials of a balloon would be torn to pieces either by resistance to the wind, or by being impelled rapidly through the air. In the trial of the apparatus, as reported in the French journals, the aeronaut succeeded in raising himself forty feet, and he descended but a short distance from the starting point. The feat is excellently calculated to astonish the children, and we commend this aeronaut to the notice of the spirited proprietor of the Surrey gardens.

Plan for Burning Waste Coal.—Dr. Clanny has contrived the means of burning the small waste coal, called in the collieries *duff* coal, which has hitherto been burnt at the pit's mouth or thrown away as useless. The object to be accomplished is to form the powdery coal into small lumps, so as to enable the heat of the fire to penetrate, and the air to have access to the heated coal. The readiest means that suggested for effecting this was to enclose the duff coal within a substance not readily destroyed by heat, and thus to make it into small parcels of the requisite size. After numerous experiments Dr. Clanny found that coarse brown paper, soaked in a strong solution of muriate of ammonia (sal ammoniac), in the proportions of one ounce to ten of water, answered the purpose completely. He twists the paper into the form of sugar papers, each packet holding about one pound. These parcels of coals when put on the fire permit the air and the heat to circulate round them, and the outer surface of the coals soon becomes sufficiently converted into coke to hold the interior loose mass together before the paper is consumed. The fire produced by the combustion of these parcels of coals is very bright and blazing; the carburetted hydrogen issuing as it is generated through the interstices of the coating of coke. When the gaseous combustion is ended, the remaining cinder is represented to be a capital article,—far superior to the cinder of ordinary coals. It forms, indeed, a kind of coke, for as the air is excluded by the crust of coke first formed, the carbon of the coal must remain nearly as intact as when heated in a retort. The advantage of this contrivance for using waste coal will of course depend on its expense, and it is estimated by Dr. Clanny that the kind of paper he uses, and the cost of the solution, are so trifling that there would be great economy even in the coal districts in burning the duff coal in this manner.

New Mode of Extinguishing Fires.—Dr. Clanny proposes to apply the incombustible properties of muriate of ammonia as a means for extinguishing fires. Muriate of ammonia dissolved in the proportion of five ounces to each gallon of water, would be much more efficacious in extinguishing fire than double the quantity of water alone. The practicability of any such plan may, however, be questioned, for it would involve the necessity of each fire-engine carrying its supply of extinguishing liquid. It would also involve a complete alteration in the construction of the engines, to protect them from the actively corroding properties of the sal-ammoniac. Neither is the plan so novel as Dr. Clanny supposes, for it has long since been proposed to employ saline solutions for extinguishing fires. We are not aware, indeed, that muriate of ammonia has been previously proposed for the purpose, but the peculiar inconvenience attending its use, from its corrosive action, would render it, practically, much more objectionable than most other solutions possessing anti-igneous properties.

Preservation of Timber.—A new process for the preservation of wood from decay has been submitted to examination by Mr. Payne. It consists in immersing the wood first in a solution of sulphate of iron (copperas,) and then producing a vacuum in the tank containing the liquid. The air in the pores of the wood consequently escapes, and when the pressure of the atmosphere is again admitted, the sulphate of iron is forced into the vacant pores. The wood is afterwards immersed in a tank containing chloride of calcium mixed with water, and the process of exhaustion is repeated. The chloride of calcium where thus forced into the pores of the wood is said to be decomposed, and forms with the previously injected sulphate of iron a new solid compound, sulphate of lime (plaster of Paris.) The specific gravity of the wood thus prepared is nearly doubled. This plan differs from the kyanising process principally in the nature of the solution employed, corrosive sublimate being the substance used in the latter. The comparative merits of the two preparations can be tested by time alone. In the process of M. Boucherie, which received the sanction of the French Academy of Sciences, the preserving fluid is injected into the living tree, and the vital energies of the plant are made available towards imbibing the solution. Of M. Boucherie's plan, an account is given in our first number.

A Speaking Machine.—An ingenious mechanician at Hamburgh, named Faber, is stated to have invented a speaking instrument which imitates correctly the sounds of the human voice. It consists of an imitation in caoutchouc of the larynx, the mouth and palate, and it is worked by the aid of bellows, in the same manner as an organ. The inventor, by touching certain keys, can make the instrument speak (in German, of course,) and even sing. The compass of the artificial voice is, however, very limited, and the sound rather disagreeable; but in subsequent trials the inventor hopes to overcome these defects. This invention, if the accounts can be relied on, is a great advance on any previous attempts of the kind, the highest attainment having been to produce two or three articulate sounds.

Victoria and Albert Steam-yacht.—We have taken the trouble of visiting this vessel, and must say that she is the best specimen of naval architecture we have yet seen from our Government dockyards. The materials are, of course, excellent, and appear to be well put together; and the form and finish of the vessel are greatly superior to what we expected to have found them. In fact, in point of beauty, this vessel will not suffer by a comparison with our Clyde-built steamers; and there are none other of the Government-built steamers we now recollect of which we could say so much.

The engines of this vessel are now being put on board: they are by Messrs. Maudslay and Field, and display a profusion of bright work, to dazzle the eye of royalty. The engines are of the direct action kind. The engine framing is almost entirely composed of malleable iron, and is of a very expensive description. The paddle-wheels are of that description known as Morgan's. They are made of unusual strength; and into the part in which the axis of the float turns a steel bush is fixed, to give it greater durability. In the boilers there is nothing very peculiar.

So far all is well: but there is one grievous blunder which has been committed in the arrangement of this ship, which will go far to negative all her excellences. The engines are much in the usual place, but the boilers are situated *before* the engines; as are also the coal-boxes, which are calculated to carry a large quantity of coals. Before this, again, the ship's stores are carried, and provisions for eighty men; while the only counterpoise to all these accumulated weights before the centre are the Queen and Prince Albert behind it! The consequence of this defect in the arrangement must be, that the ship will swim greatly by the head. Iron ballast may, indeed, be put in the stern part of the ship; but a prodigious quantity would be requisite to bring the vessel into trim; and the addition of so much ballast would not merely impair the speed of the vessel, by sinking her very deeply in the water; but if placed far aft, would have a tendency to strain the vessel in a sea way, and give her bad sea qualities. The purpose of the existing bad arrangement, we suppose, is to prevent the heat of the boiler incommoding the Queen; but a good double bulk-head, filled between with sawdust, would have completely attained the end, and, in vulgar vessels, is perfectly effectual. We have no patience with such childish freaks. The boilers, even yet, should be put in their proper places.

Marble Cement.—We have visited Messrs. White and Sons' manufactory at Westminster, to add to our knowledge of the cement manufactured by them; and which is intended to fulfil the purposes of marble and stone. The only drawback this cement has is, that it is not a hydraulic one;—it will not resist water, and is therefore unsuitable for out-of-door purposes; but for all imitations of marble and stone for interiors of houses, it appears to us to be a most valuable material.

There are several qualities of the cement; the coarser being intended for purposes where stone or tile is used, such as for floors, walls, mouldings, etc.; and the finer for situations where marble is generally employed. All the different kinds are to be had, of various colours; and works in Mosaic may thus be executed in the cement, with great facility. The imitations of granite and variegated marbles, executed in the cement, it is perfectly impossible to distinguish from the real articles; and an admirable effect is obtained by inlaying one marble with another; which, with this cement, can be easily done. A sort of fresco, too, may be made with this cement, by painting one colour into another; and the picture, when finished, may be brought to the polish of marble. This species of ornament appears to us well adapted for tables. It is highly beautiful, and, we are informed, is durable and inexpensive.

In many edifices, the various mouldings round the rooms, which used formerly to be of wood, are now made of this cement,—a purpose to which it seems well adapted. In the Bedford offices, for example, of which an account is given in our first Number, the various mouldings are thus formed. The white marble made from the cement is a failure: it is more like crockery ware than anything else.

Electro-plating.—We have also paid a visit to Messrs. Elkington and Co.'s factory, 45, Moorgate-street, for plating or re-plating anything with any metal, by the aid of electricity. We cannot, at present, describe the minutiæ of the process, but trust to be able to do so next month; and we shall now merely give a few of the principal results, as they came under our own observation.

The chief purpose to which the process has hitherto been applied is to that of silvering and gilding. It is now, however, being extended to more serious works, and promises to be of the greatest utility. Iron, zincked by this process, will, we have no doubt, very soon be used for the construction of boilers, the paddle-wheels of steam-vessels, and other similar purposes, and will resist corrosion almost as successfully as copper. Iron, covered with copper, is also susceptible of many useful applications. Air-pump rods, for example, if made in this way, would probably be as good as if made of solid copper,—perhaps better. We are not sure, too, that iron bolts, covered with copper, might not be introduced advantageously for fastening ships. Bolts of pure copper heat and expand in the driving; and, by their subsequent contraction, are left too small for the hole; but iron bolts, covered with copper, will not heat any more than iron itself. There is no danger, we understand, of this copper covering peeling off: the bolt may be heated in the fire, and quenched in water, without loosening it in the least; and may be driven through a log of oak, without any symptoms of injury. At Messrs. Elkington's there are two iron bolts, one coated with zinc, and the other with copper, which have been driven through an oak block, and they are just as perfect as before being subjected to that *experimentum crucis.* The driving, however, and the riveting, injures the ends; and this is an objection. Perhaps it might be surmounted by placing a small piece of copper or zinc bolt at such a distance from each end of the iron bolt that the intervening space might be filled up by the electro-depositing process. We should thus have an iron bolt, with zinc or copper ends, all homogeneously coated; and such a bolt might be driven or riveted without penetrating to the iron.

An anomaly in Steam.—A strange circumstance, connected with the action of steam, has come to our knowledge, to which we should have given no heed, as being incredible, except that the quarter from whence the communication came, adds weight to it. We give the narration as we received it.

The Blackwall railway engines have stopped, on a few occasions, in consequence of the fireman having let down the steam. On these occasions, just before the engines stopped, the steam raised the escape valves of the cylinders, and blew out; thus indicating an excess of pressure in the cylinders, at the same time the engines were on the point of stopping from a want of pressure! We immediately, of course, objected to this, that the slide-valves must, before this escape of steam took place, have been thrown out of gear; and that the escape of the steam from the cylinder safety-valves was the effect merely of the compression produced by the momentum of the engine, the ports being shut; but we were assured that the eccentric rods had not been thrown out of gear at the time the escape of steam took place.

Iron Steamers.—Messrs. Miller and Ravenhill have just launched one iron steamer; and another, called, or to be called, the *Prince of Wales*, is now nearly completed. This vessel is to ply between London and Margate, and promises to be very fast. Her chief dimensions are as follows:—

Length of keel . .	180 feet.
Breadth of beam .	22 —
Depth of hold . .	10 6 in.

To be propelled by two engines, of 68 horses' power, taken out of the *Royal George*, a vessel recently broken up. These engines are by Messrs. Miller and Co.; and, with the refitting they are now undergoing, will be as good as new. The vessel is one of the handsomest models we have seen.

The Mermaid.—The engines of this vessel are one of the best specimens of good taste and good workmanship we have seen for a long time. The several parts are conveniently and symmetrically arranged: they are also well proportioned and judiciously planned; but we think some of the particulars are needlessly elaborate, and evince too great an ambition for display.

Turkish Steamer.—A new steamer, with an impracticable name, intended for the Turkish government, is now lying in the East India Dock, and is about ready to start. The engines are by Messrs. Miller and Ranchill; the ship, we believe, by Messrs. Fletcher and Co; and has, we suppose, been constructed in the conviction that the Turks are no judges of beauty. We never saw a more uncomely beauty, even out of Messrs. Fletcher's harem.

MISCELLANEA.—The *Iberia* steamer, which lately lost her rudder on the Lisbon bar, is now in the East India Dock. She is about to get new boilers put in, and to undergo a thorough repair.——By the way of benefiting the iron trade, Mr. Bush proposes to construct a harbour on the Goodwin Sands] of iron. The scheme will, of course, receive the support of iron masters and shareholders in Bedlam.——Dr. Ure has assumed his armour, in the shape of a small pamphlet, with the intent of making a desperate onslaught on Professors Brande and Graham. It seems Dr. Ure found alcohol in some mixture in which the other learned men could not find any; and the doctor is therefore filled with alarm for the British school of chemistry, and with wrath most virtuous against those degenerate sons by whom its reputation is put in danger. It is not that Dr. Ure wishes to exalt himself by pulling down others,—that is not to be supposed, for the doctor is known to be an honourable man; but all his concern is for science. We really think the doctor's solicitude should begin nearer home: there is nothing by which science is more effectually lowered than by such unseemly displays as those of which he himself stands convicted.——An immense engine is being constructed at Hayle Foundry, in Cornwall, for draining Haarlem lake, in Holland. The engine is to be on Wolf's plan, the small cylinder being placed *within* the big one. The piston of the big cylinder is consequently an annular one. The annular piston has four piston rods, and the central piston, one. These rods are attached to a great cast iron frame, which is moved up and down by them; and from this frame the motion for working the pumps is derived, by means of levers standing radially round the big cylinder, the pumps being at the outer ends. The following are some of the chief dimensions:—Diameter of great cylinder, 12 feet; diameter of small cylinder, 7 feet; length of stroke, 10 feet; diameter of pumps, 5 feet 3 inches; length of stroke, 10 feet; number of pumps, 11. The plan is, in our opinion, a bad one. The annular piston it will be very difficult to keep tight; and the equilibrium of the frame on top of the piston rods will be deranged, if any of the pumps be thrown out of connexion, as must sometimes be the case.——The patent cause, depending between Mr. Neilson, patentee of the hot blast, and Messrs. Baird, of Gartsherrie, and others, has been determined in favour of the former.——Mr. Barry has put out a very important report on the decorations and improvements in the vicinity of the new Houses of Parliament, which has been published in the *Morning Herald* and other papers. The most interesting part of it is that wherein he proposes the formation of a new street, raised upon arches, along the side of the Thames; the surface of the road being brought up to the level of the approaches to the several bridges, which would leave abundant room beneath, for access to the wharfs and warehouses on the river side. Mr. Barry says, he is convinced a road might be made, without difficulty, on the south side of the river, from the *termini* of the South Eastern and Brighton railway to the end of Vauxhall-bridge.——The Greenwich pier has been totally demolished. The fault, we understand, was the thinness of the wall, and the filling in behind it with gravel instead of concrete. The pressure of the gravel forced out the wall into the river.——Mr. Whitclaw has inventd an ingenious mechanism for ascertaining the strain exerted on a belt. One of the pullies is put loose on the shaft, and attached to a spiral spring fixed on the shaft. When put into operation, the pulley compresses the spring to a degree corresponding to the strain, and the result is read off on an index.

STEAM ENGINE PISTONS _ LAND AND LOCOMOTIVE

Fig. 1.

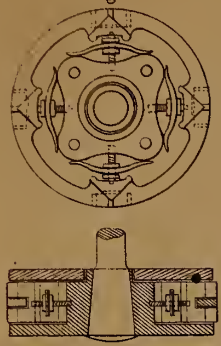


Fig. 2.

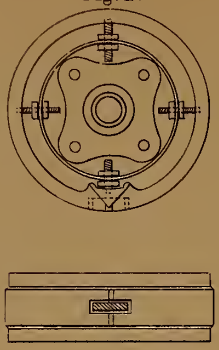


Fig. 3.

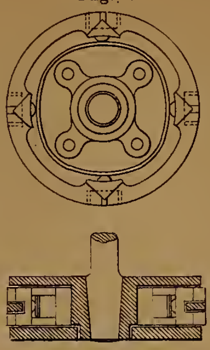


Fig. 4.

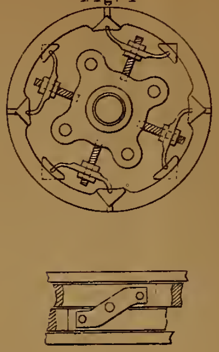


Fig. 5.

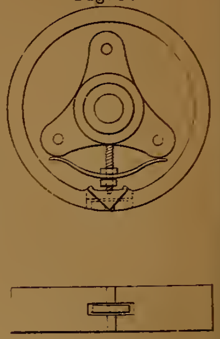


Fig. 6.

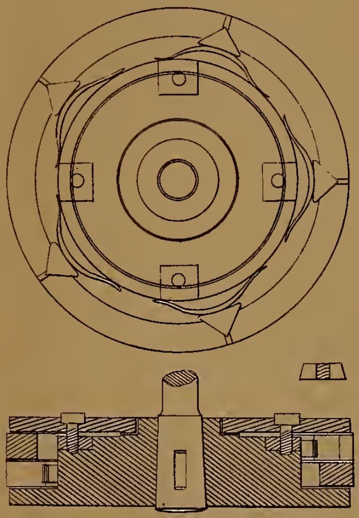


Fig. 7.

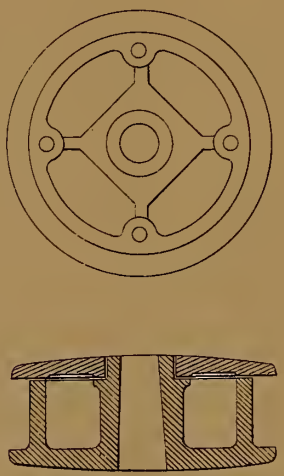


Fig. 8.

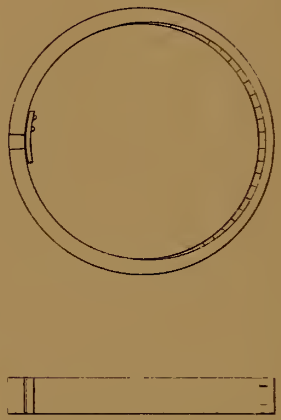


Fig. 9.

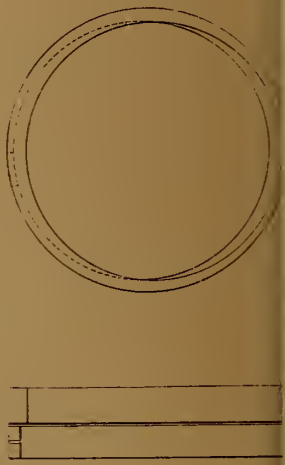


Fig. 10.

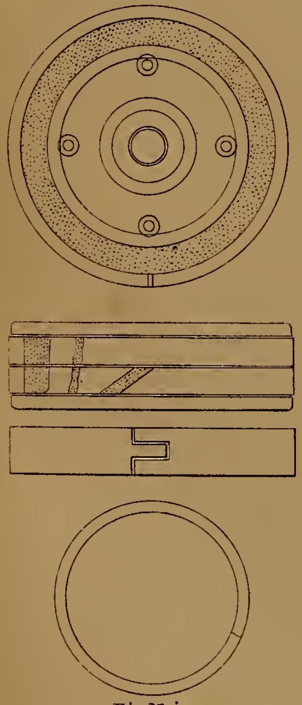


Fig. 11.

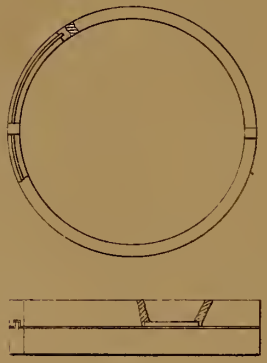


Fig. 12.

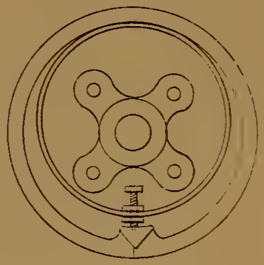


Fig. 13

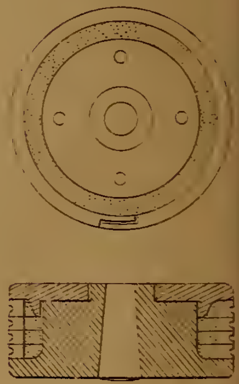


Fig. 14.

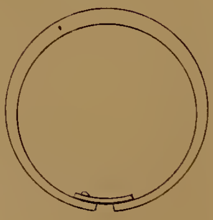


Fig. 14'.

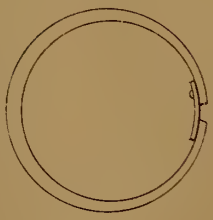


Fig. 15.

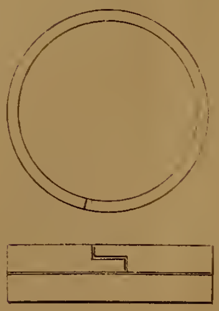


Fig. 16.

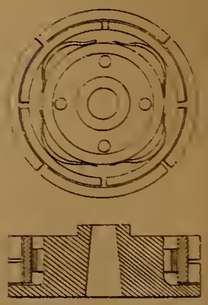
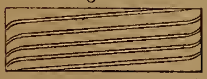
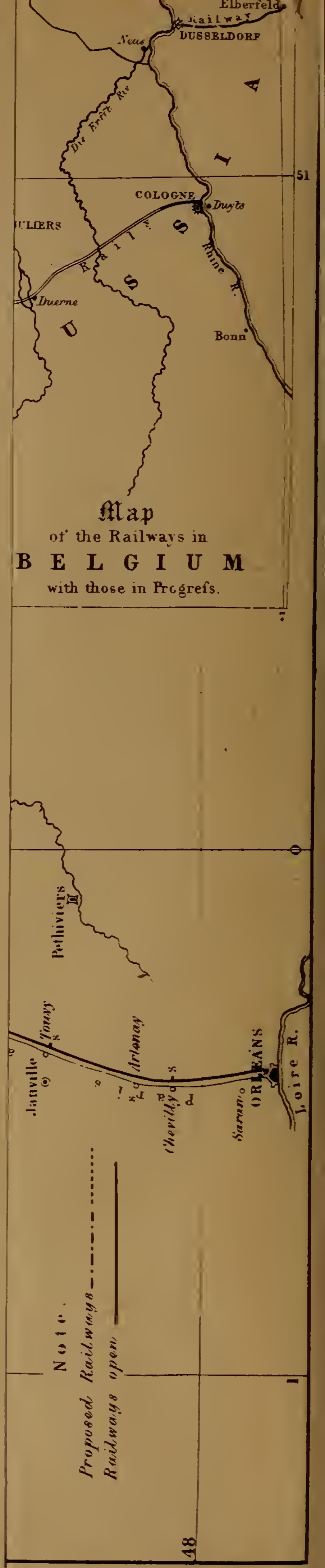


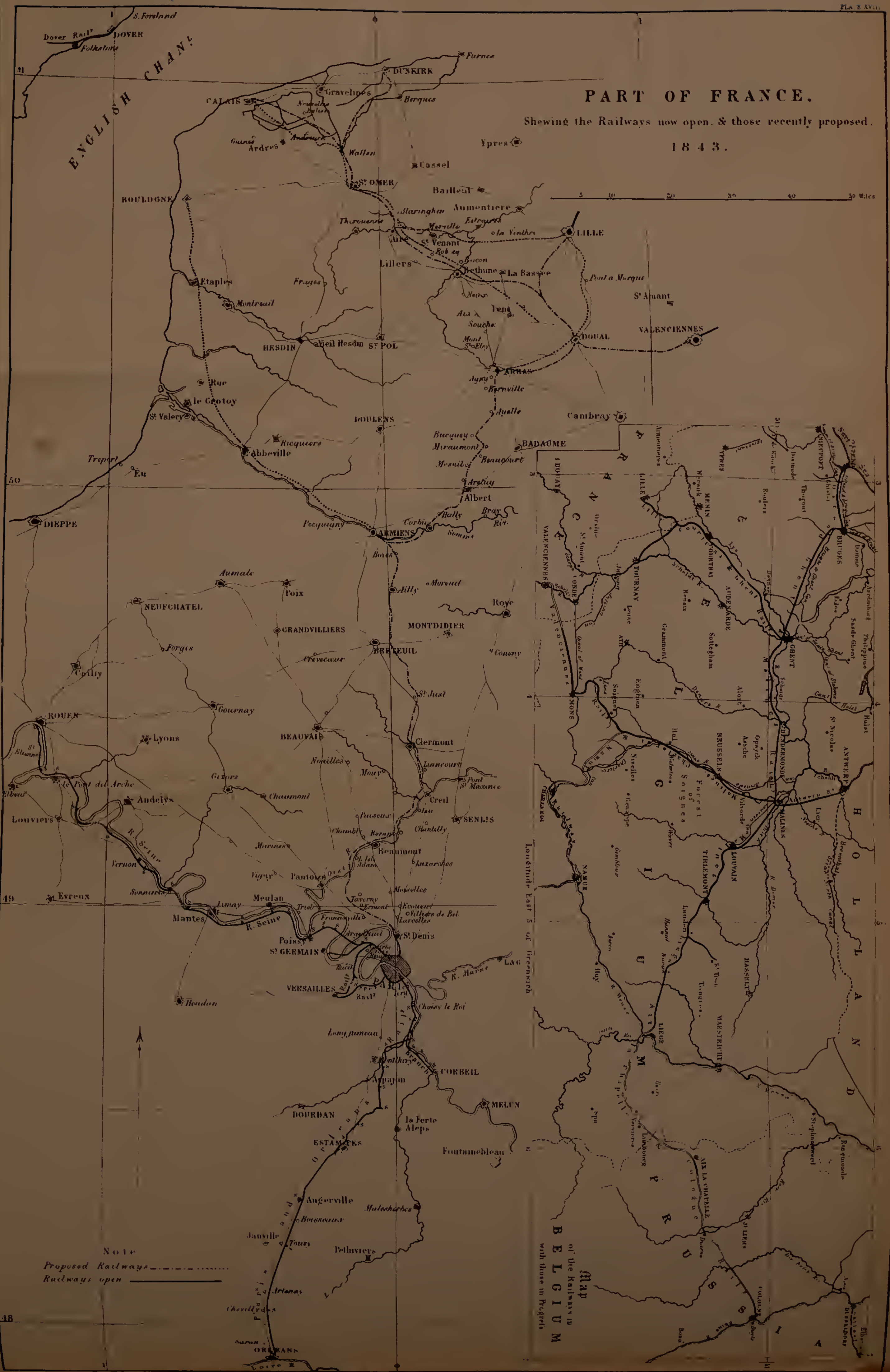
Fig 17.



J. R. Jobbins.



Map
of the Railways in
BELGIUM
with those in Progreſs.



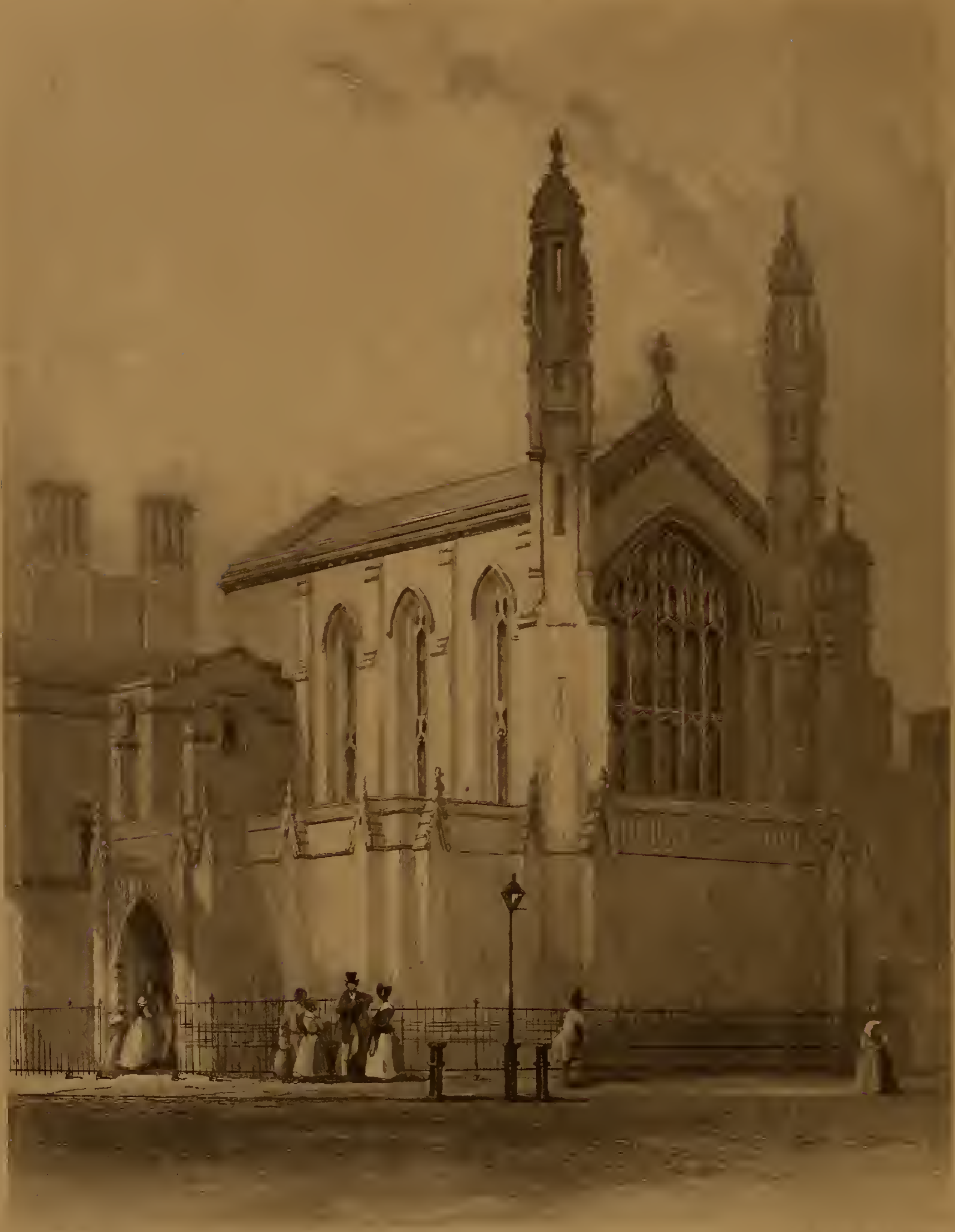
PART OF FRANCE.

Shewing the Railways now open, & those recently proposed.

1843.

Map of the Railways in BELGIUM with those in Progress

THE ARTIZAN PHOTOGRAPHIC VIEWS No 1



BEARD'S PHOTOGRAPHY [illegible]

The French Protestant Church

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THE ARTIZAN.

No. VI.—JUNE 30th, 1843.

Art. I.—THE RAILWAYS OF FRANCE AND BELGIUM.

The railways of France and of Belgium present interesting subjects for consideration, to all who desire that the steam-engine as applied to locomotion shall be rendered available to the utmost, in facilitating the communication between distant places. The railway's of Belgium have been established and conducted on a system entirely different from that pursued in this country, and as they have now been in active operation for eight years, we are enabled to make a satisfactory comparison between their mode of management and our own; and to ascertain whether government control, or unfettered commercial enterprize, is best calculated for the developement of the capabilities of steam locomotion, and afford the greatest amount of benefit to the community. In Belgium, indeed, it was not, as in this country, a matter of choice whether the Government should or should not interfere directly for the establishment and management of railways. No private capitalists could have been found there, in the commencement of railway enterprize, to undertake the formation of railways throughout the country. The Government, however, quickly saw the immense advantages to be derived from that improved mode of communication, and boldly ventured to stake the national resources for the accomplishment of an object which promised such important national benefits. In 1834, a project for a complete system of railways was submitted by the Minister of Public Works, to the Legislative Chambers, which met with general approbation, and the money required for the purpose was freely voted.

The means being thus placed in the hands of the Government, for carrying their plans into execution, measures were quickly adopted for giving effect to the law. Mr. Simons, an Englishman, and M. Doridder, were appointed to form the plan of a chain of railway communication, that should connect all the chief towns in the kingdom, and spread the "road of iron," as a net over the country. The town of Malines (Mechlin) was selected as a central point, whence all the lines were to radiate. The completion of this system of communication required an extent of 113 leagues of railways, and the estimated cost was £5,236,000, which, to the credit of the engineers, it must be stated, was not exceeded by the actual expenditure. The works were prosecuted with much vigour, and early in 1835, less than a year from the promulgation of the law for the formation of railways, the section from Brussels to Antwerp was opened. Each succeeding month saw link after link added to the chain, till the whole was completed.

As Malines is the centre where all the lines unite, it is also the central depôt, whence the trains to all parts of the kingdom start, and to which they are all directed; the passengers being there transferred to other trains for the points of their destination. Some inconvenience, indeed, arises from this centralization of the traffic in one town, but the greater convenience it presents in the management, we suppose, induces the Government to disregard the annoyance to passengers of being taken out of their direct course.

One prominent advantage arising from the formation of railways by the authority of Government is, the avoidance of preliminary charges, and the waste of money which all the Railway Companies in this country have had to incur, and which press as a dead weight on their subsequent operations. In Belgium, no bribes were required to prevent opposition, no fees to lawyers, no expenses from competition with competing lines before the sanction of the legislature was obtained for the undertaking. On the London and Birmingham line, the compensations to land-jobbers swept away upwards of £700,000; the mere cost of the Act of Parliament was £72,000, and other law charges and engineering amounted to nearly the same sum; so that in these preliminary expenses alone, nearly one million sterling was squandered; the greater part of which would have been saved, had the Government come forward and supported railway enterprize as a national concern. The waste of money on the other railways of England was even more shameful, in proportion to their comparatively limited extent, and the sums thus sunk have tended materially to deprive the public of the full advantages they have a right to expect from the important invention of locomotion by steam power on railways. The railways in Belgium possessed also a greater advantage over the railways in this country in the economy of their construction, which must be principally ascribed to the level nature of the country. Notwithstanding the higher price paid for the rails, and the locomotive engines, which were at first imported from England, the average cost of the Belgian railways is stated in the official report of the Government at only £16,200 per mile. The expense of the London and Birmingham railway was £48,000, nearly three times the amount, and none of the railways in this country have cost, on an average, less than £23,400 per mile. This great disparity in the cost of construction, may be partly accounted for from the circumstance that a great portion of the railways in Belgium have but one line of rails; the railways in England are also generally much better finished and fenced.

Having thus shown the advantages Belgium derived in the construction of her railways from the authority of Government, we will next examine whether the system of State management operates beneficially in the details of conducting the traffic. The first circumstance that arrests attention in comparing the railway conveyance of Belgium and England is, the low rate of the Belgian fares, which are less than one-half those charged on most of the railways in this country. This favourable feature in State management may be attributable in a great degree to the originally low cost of construction, for the passengers by English railways are compelled to make good, by paying higher fares, the capital wasted among land-jobbers and lawyers. Independently, however, of this dead weight with which the English railways have to contend, another, and more influencing cause of high fares is to be found in the principles which guide the management of railways conducted by trading Companies. In Belgium, railways have been established and conducted principally with a view to promote the national welfare. In England individual gain has been the actuating motive. In fixing the railway tariffs of the two countries, therefore, the rule in Belgium has been to protect the revenue from loss; in England the object has been to charge as much as could be done without injuring the traffic. In Belgium, consequently, the per centage of the expenses on the receipts is much greater than is usual on the lines of railway in this country. In 1835, the first year of traffic on the Belgian railways, the expenses of working and repairs, compared with the receipts, were 62 per cent. In the following year they were 52; in 1838, they were as high as 88 per cent., but they have since lowered to 61 and 68. It is customary to estimate the average per centage of expenses on the receipts at 50, but on the great and profitable lines the expenses bear a much less proportion. On the London and Birmingham railway, for example, the cost of working and repairs does not exceed 34 per cent. on the amount received.

On the all-important point of safety, the system of State management, as exemplified in the railways of Belgium, far surpasses the railways in England. During the first four years that the Belgian railways were in operation, only *one passenger* was killed, by means for which the railway and its management could be in any way responsible. Several other passengers suffered from mounting and dismounting while the trains were in motion, but for these reckless acts themselves alone were answerable; two persons also suffered death on the railway wilfully, by placing their necks across the rails as the engines approached, and were thus guillotined. So small an amount of life sacrificed on the introduction of this great experiment in rapid locomotion, is evidence of careful regulations strictly enforced, such as we fear no railway undertaking in this kingdom can exhibit, notwithstanding our superior skill and longer experience. This security from danger, on the Belgian lines is, we believe, to be attributed principally to the greater number of guards, who are placed within sight of each other, and are enabled to communicate by appointed signals with great rapidity from one station to another. Consideration of the half-yearly dividend has induced the Directors of several English railways to diminish the number of guards, much below the amount which a due regard to safety requires; no parsimonious consideration of this kind is likely to influence the conduct of State managers to the danger of the public. The inference to be drawn from the preceding comparison of the two systems of management, which distinguish the Belgian from the English railways is, abstractedly, decidedly in favour of the latter on the two essential points of economy and safety; but it may be questioned whether in this country the management by the Government of the principal means of conveyance would accord with the habits and feelings of the people. We are so much accustomed to self-government in matters which in other countries are regulated by the State, that we might, perhaps, think the advantages of cheapness and safety too dearly purchased by the extension of Government influence and power which the direction of the railway conveyance of the kingdom would occasion. But is there no middle course between the State management and the total disregard with which these important national undertakings have been viewed by the Government of this country? We turn to France, and find there a system adopted which promises to secure the advantages of encouragement by the State, with the independence of individual control. It is true, that France had time to avail herself of the experience of England, Belgium, Germany, Italy, and America, before any active measures were adopted there for obtaining the advantage of railway conveyance. The importance of the subject was not overlooked, but enterprizing capitalists were wanting, and the Government could not be roused into action, until they were shamed by seeing nearly all the States of Europe exerting themselves for the construction of railways, whilst France alone seemed dead to the general movement. In 1835, when the Belgian railways were being constructed and partially opened, the French Minister proposed to the Chambers a vote for 500,000 francs for surveys, to ascertain the most desirable lines for railways to all parts of the kingdom, and also the probable expenditure and traffic. These surveys were completed in 1837, and presented in the form of elaborate reports, or "memoires," accompanied by maps on a large scale, with minute details of the works to be constructed, of the traffic on the roads, and rivers, obtained from official sources, with estimates of the cost and revenue to be derived from the undertakings. The principal lines of railway projected in these reports radiated from Paris, as the centre, to the Mediterranean, to the English channel, and the Bay of Biscay, and they proposed also to connect the capital with the frontiers of Belgium and Germany. The line from Paris to Lyons, with its continuation from Lyons to Marseilles, was the most extended; and the advantages to be derived from railway conveyance on this line are represented by the engineer, M. Keimaingant, to be so great that it seems strange the project has been allowed to linger from that day to this without having been effectively carried into execution. The conveyance of merchandize from Lyons to Marseilles, by the Rhone, occupies generally upwards of thirty days; by road, goods are transmitted in ten days; and the diligences occupy generally more than forty hours in the conveyance of passengers. The time required to complete the transit of goods by railway would be fourteen hours, and passengers would be conveyed in ten hours. The proposed cost of conveyance by railway would be 3 francs per ton less than by water, 23 francs less than by land, and, for passengers, 8 francs less than by diligence; yet, allowing only the same amount of traffic on the line, with these advantages of speed and economy as at present, the receipts per annum would amount to 11,530,000 francs; and allowing 50 per cent. for the expenses of working, there would be a surplus of profit of 5,765,000frs. to remunerate the shareholders. The estimated expense of the construction of this line is 52,000,000frs.; therefore, even supposing there was no increase in the traffic, and no reduction in the annual expenses, this railway would pay more than 11 per cent. on the money advanced. Yet, with these prospects of gain, French capitalists would not engage in the undertaking; and after the presentation of these reports, the railway projects, with two exceptions, lay dormant until the Government were induced to offer direct encouragement for their formation.

In 1840, a grand *projet de loi* was presented to the French Chamber of Deputies, by which it was proposed to establish five lines of railways, all centering in Paris. The means of carrying this project into effect, combined, in a great measure, the advantages to be derived from Government support with the vigilance and economy of private enterprize. The Government proposed to provide all the necessary land, and to construct the whole of the earthwork, bridges, and stations, at the cost of the nation. This portion of the works has proved in this country far more costly than the laying of the rails, the ballasting, and the locomotive department, which the French Government leave to be executed by the company of individuals who engage to complete the railways. In return for these advantages, the Government are to become proprietors of the railways at the expiration of thirty-five years from their opening, on payment of a just value of the stock when taking possession. According to these conditions, the railway companies of France will obtain, at half the original cost, all the advantages to be derived during thirty-five years of active operations; and at the expiration of that time they will receive full value for the materials on which their capital has been expended. This plan seems admirably calculated to invite monied men to embark in railway speculations; whilst, in a national point of view, it presents the advantage of securing to the public the absolute possession of those important works within a space of time that is but insignificant in the existence of a nation.

Previous to the adoption of those vigorous measures by the French Government in 1840, many railways of small extent had been constructed in different parts of the country, and companies had been formed for constructing railways on two of the important lines indicated in the reports of the French engineers—those from Paris to Rouen, and from Paris to Orleans; it being intended to continue the former to Havre, and the latter to Nantes, *via* Tours. For the formation of these lines, however, French capital alone was insufficient. The aid of England was obtained; and as the object of facilitating the communication between England and Paris gave the Rouen and Havre railway an English character, shares were freely taken by the capitalists of this country, whose stake in the undertaking fully equals that of native capitalists. The construction of the line from Paris to Orleans was also greatly aided by English money; and assistance having also been obtained from the Government, the works were prosecuted latterly with vigour. At the beginning of May, in the present year, both of those important lines were opened as far as to Orleans and to Rouen; and we have now before us the *Guide du Voyageur sur le Chemin de fer de Paris à Rouen*, and a similar railway-guide from Paris to Orleans, containing the regulations of the railways, the fares, and a description of the country passed through. We have also a *Programme-Itineraire* of the railway from Paris to Rouen, adorned with numerous well-executed wood engravings of the remarkable places passed *en route*. The fare, in the first class carriages, from Paris to Orleans, a distance of eighty miles, is 12f. 60c., equal to about 10*s.* 6*d.*; in the third class, uncovered, the fare is 6f. 35c. The fare from Paris to Rouen, also a distance of eighty miles, is 16f. in the first class, 13f. in the second class, and 10f. in the third class carriages. The journey is performed in four hours and a quarter, and there are seven trains each way every day in the week, Sunday included.

On comparing the preceding scale of charges with those on the English railways, we perceive that we have no reason to boast of practical benefits from our superior engineering skill; nor have the French to lament, comparatively, having been compelled to employ English labour, English skill, and English materials in the construction of their railways; for, notwithstanding these disadvantages, they are enabled to enjoy the convenience and luxury of railway travelling at half the price we are compelled to pay for it in this country.

Of the railway surveys completed by the French engineers, that for establishing a direct communication between Paris and the nearest English port is of the most interest in this country. M. Vallée, to whom the survey of the northern railway communications was entrusted, presented estimates and surveys for a line of railway to Amiens, thence branching off in one direction towards Boulogne, in the other towards Lille, and thence to Calais. The importance of these northern lines, in relation to the South-Eastern Railway to Dover, induced the Directors of that Company to appoint Mr. Robert Stephenson to survey the country, and to examine whether any improvements could be made in the lines laid down by M. Vallée. The report presented to the Chairman and Directors of the South-Eastern Railway Company by Mr. Stephenson, is an able, and appears to be a well-considered, statement of the works to be undertaken, and of the comparative advantages which the proposed lines present, as regards the probable traffic, the distances, and expense. In the route from Paris to Amiens he proposes the same route as M. Vallée; but in the route from Amiens to Calais he suggests several alterations, which would materially diminish the cost of construction. In considering the comparative advantages of Calais and Boulogne, as the ports of communication with England, Mr. Stephenson gives preference to the route by Calais; but in this choice he is guided rather by the greater traffic to be anticipated on the Calais route than by the mere question of speedy communication with England. It is admitted that, by the railway from Amiens to Boulogne, the communication between Dover and Paris might be completed in two hours less time; but that line would pass through a country from which little other traffic could be obtained; whilst in the Calais route are included St. Omer, Dunkirk, Lille, Douai, and Arras, besides forming a chain of communication with Belgium from Lille to Ghent, which line is in course of execution.

The main object, no doubt, which the Directors of the South-Eastern Railway had in view, in appointing Mr. Stephenson to survey the line, was to inspire more confidence in English capitalists, and to induce them to engage in an enterprize on the execution of which the success of the South-Eastern Railway is greatly dependent. The result is certainly calculated to answer their expectations; for it appears from Mr. Stephenson's estimates, founded on the best possible basis, that the profits on the working of the Calais and Paris Railway would amount to 14 per cent. for the thirty-five years during which their contract with the Government would last. The total estimated expense of the railway from Paris to Calais is £6,109,306; and as the Government would bear half the burthen, the cost to the shareholders would not exceed three millions sterling to put the railway in working order. Mr. Stephenson has founded his calculations on the actual cost of those railways in England which traverse a similar country to that over which the Calais Railway would have to be constructed. He observes, also, in vindication of the differences so often complained of between estimates and expenditure, that those differences principally arise from the compensations paid to landowners; and as the French Government undertake to furnish the land and the earthworks, the remaining portions of the expenditure to be borne by the shareholders can be estimated with great accuracy.

The probable traffic on a railway can be calculated with much precision in a country like France, which has internal imports on the transit of goods from official returns, instead of being dependent, as in this country, on the uncertain calculations of persons placed on the roads to count the number of vehicles and passengers. It results from these returns, that the conveyance of merchandize would realise 12,636,740fr., and of passengers, 8,490,219fr.; making the total yearly receipts £845,078. In this statement no allowance is made for increased traffic arising from increased facilities of conveyance and reduced rates of travelling: and in estimating the receipts of the passenger traffic, the fares are assumed to be 40 per cent. lower than by existing conveyances. The per-centage of yearly expenses on receipts is taken by Mr. Stephenson at the high scale of 50 per cent., which is 16 per cent. higher than on the London and Birmingham Railway; therefore the annual profits would be £422,589 on the three millions capital invested, or 14 per cent. for thirty-five years. The probable value of the stock at the expiration of the term, Mr. Stephenson estimates at £1,062,488, or equal to a dividend of 34 per cent. on the subscribed capital.

Encouraging as these estimates must appear to railway speculators, we believe that Mr. Stephenson has under-rated rather than exaggerated the profits that would result from the undertaking if no competing line of railway were established to divide the traffic. It must be borne in mind, however, that the railway from Rouen to Havre is in advanced progress, and that the communication with Paris in that route from Southampton will be established long before the Calais Railroad can be in operation. The railway route by Boulogne also, would, if completed, effectually divert the traffic between England and Paris into that direction. But, notwithstanding these probable drawbacks, the increased traffic arising from more speedy and cheaper conveyance, would, we feel confident, make good any loss to be derived from the diversion of the direct traffic between England and Calais.

Among the lines of railway projected in France, the one from Paris to Strasburgh will, perhaps, be the most important in its results. Strasburgh is now the terminus of railways that would place Paris within a comparatively few hours' communication with the principal towns in Germany: even the frontiers of Russia and of Turkey might be reached by railway. We are not aware that any measures have been adopted for carrying this important work into execution. When, indeed, we look at the map of France, and trace the small extent of its surface where railways are formed, or are in the course of construction, the insignificance of those undertakings, compared with the vast field that lies open for further progress, becomes at once apparent, and we are induced to form but a low estimate of the enterprize of the nation that is so backward in taking advantage of this great invention of the present age. Even the little that has been accomplished would not have been effected without the aid of the enterprizing capitalists of England; but it is to be hoped that the example now afforded by the opening of two important lines will be the means of operating as a salutary stimulus, and that, with the encouragement afforded by the Government, the French railways will, before long, be more worthy of a nation which has the vanity to call itself the queen of the world!

Art. II.—THE COLLEGE FOR CIVIL ENGINEERS.

It may, perhaps, be in the recollection of some of our readers, that we indulged in some remarks on this institution in a former number. We have recently taken occasion to visit it, for the purpose of ascertaining whether any of the improvements we suggested had been carried into effect, and we now purpose to lay before our readers the result of our observation. Before doing so, however, it may be worth while to notice a few of the objections which have been made to our former articles.

Our remarks, then, it has been objected, though to a certain extent plausible, were built upon the reprobation of certain regulations and abuses which are now obsolete; and were penned, moreover, in a hostile spirit. Now, neither of these charges has, in our belief, any foundation in fact; though the latter one, we admit, may have some *appearance* of fact to support it. Our strictures upon some parts of the College economy, though substantially just, may, we admit, have been too severe; but we deny that any such severity was the result of a hostile feeling on our part towards the College administration. The species of writing, indeed, in which we are engaged, is naturally productive of a tendency to praise or blame too strongly. The urgent haste in which our remarks have often to be penned, precludes that nicety of discrimination which flows from a more deliberate inquiry; and too great a regard for the dulness of our readers may sometimes seduce us into a certain tone of exaggeration which is ultimately more offensive to no one than ourselves. While, however, we freely make this acknowledgment, we must as unequivocally say, that we believe our former remarks to be substantially correct; and if the picture be not exactly a Daguerrotype one, it has, we are satisfied, a vast deal of truthful resemblance.

There is one improvement we were glad to observe, in our visit to the College, had taken place, which, we think, augurs well: there are now no tunnels or railways made, with the view of instructing the pupils in the conduct of those descriptions of work. One fertile source of ridicule is thus done away, and the pupil is saved from the delusion that his excavating pastimes are productive of acquisition of the least practical value. This improvement should be followed up by abolishing the present workshops, which are a source not merely of useless expense, but of positive injury. This, we have no doubt, is an unwelcome truth to those by whom those establishments were promoted; but it is a truth, notwithstanding, too obvious, in our eyes, to require any proof. For the sake, however, of those who happen to be of a more difficult perception, we shall squander a few words on the subject.

The purpose of the workshops, of course, is to instruct the students in the art of steam-engine making; and, in so far as they accomplish this purpose truly and thoroughly, they are useful. If, however, it be their effect merely to teach a peddling and antiquated practice,—if all those great principles which preside over factory economy be broken through in their management, and production be deprived of its necessary stimulants; if the attempt of all that is really difficult and important in engine construction be repressed by want of means, and nothing be treasured except the delusion that something of moment has been learned; and if all this be done with an habitual extravagance of time, it is plain that the student has been only learning things which must be unlearnt before he can become fitted for the serious pursuits of his profession; and that the evil habits thus acquired may be exceedingly difficult to eradicate. Now, to the whole of these objections we think the workshops of this College are open; and although they, no doubt, have the effect of adding to the familiarity of the students with the mechanism of steam or other engines, yet it is questionable whether the same degree of familiarity might not be obtained by the mere dissection and recomposition of the models of those contrivances. It is models only, or at least very small machinery, that can be made in the College workshops. The tools are inadequate to the production of anything large; and in the construction of small articles there is none of the information to be had which is to be acquired in the erection of large engines. The art of erecting consists, in a great measure, in the management of heavy weights, and in so placing the several parts, by the aid of the bevel and plummet, that the requisite precision may be readily secured. But in the fabrication of small objects, which may be turned upside down in the hand, so as to have a T square applied, there is no difficult or instructive practice; and a person, after working a century in the College workshops, would be almost as great a novice at erecting an engine of serious size as a person who had never seen one. Then, again, the College has not engines sent to it for repair, as is the case in a real factory; and repairing is by far the most instructive part of engineering practice, as it makes manifest the disadvantages of particular kinds of construction. In short, there are a thousand reasons why the workshops of this institution cannot have any material part of the benefits of a regular engineering factory, while they have disadvantages both numerous and weighty, which are all their own; and there is nothing of which we are convinced more thoroughly than that our former recommendations on this head must be effectually carried out before the College can acquire the character of a school of effectual engineering instruction.

Since the appearance of our former remarks, the College has, we understand, relinquished all pretension to the manufacture of *finished* engineers, and now restricts its operations to the preparation of the raw material for engineers' offices, where the engineering plating is laid on. If this be so, the College has manifestly dwindled to a mere school of mathematics, and might as well be located at John-o'-Groat's as at Putney. We question whether an additional school of mathematics, or mere natural science, is at all wanted; but, however that may be, it is at least certain that the relinquishment of all intention to turn out the students finished engineers is a departure from the promises originally held out, and on the faith of which many of the students entered the College. The prospectus expressly stipulates that the students shall be educated in both the practical and theoretical part of engineering, and states that, at the end of the term, a diploma will be granted—an instrument, we suppose, intended to signify that the graduate is qualified to practise. Now we do not blame the College for altering its aims and intentions; and, indeed, with so notably inefficient a factory, we think it had no alternative: but it certainly appears to us that any such change should have been preceded by a public declaration to that effect. A new prospectus should have been issued, signifying that it was the theory of engineering alone that the College henceforth proposed to teach; and the students would thus have been saved from the delusion that they were learning to *be* engineers, instead of that they were merely learning to *become* so. It may indeed be contended that the students, according to the present discipline, are mastering the elements of practice as well as the elements of theory: and so, undoubtedly, they are; but it is the elements of a bad practice, which is worse by far than no practice at all. Good practice is practice on the large scale; and practice on the small scale involves not merely a difference in the degree as regards elementary or recondite, but a difference in the thing altogether. The practice which on a great scale is important and useful, may on a smaller scale become entirely the reverse; and we certainly think that a devotion to the manufacture of engineering toys is not calculated to impart much important knowledge, or to do otherwise than encourage the growth of that latent idleness which is satisfied with a frivolous occupation. In short, the College appears to have placed itself in this dilemma: if it professes to be merely a school of theory, its existence is superfluous; if a school of practice, its defective resources preclude it from being other than a school of little, or, in other words, of bad practice: nor can these objections be eliminated, except either by the acquisition of a business-like factory, or by getting such a factory so connected with the College that its practice may be made available for the students. This appears to be the only very serious fault which now attaches to this College; and it is a fault in the plan, not in the individuals by whom the several offices are administered. The work we saw in progress at the workshop was, we are bound to say, very good of its kind; but its kind was not of sufficient importance to be the standard practice of such an establishment.

We ventured, on a former occasion, to advert to the unfavourable influence exerted by science in discouraging vigour and originality of mind, and impeding the progress of invention. That speculation was, perhaps, carried too far, yet is, we are persuaded, substantially just. We would not be understood to say anything in contempt of science, of the utility of which, to the engineer, we are highly sensible; but we believe its importance is apt to be over-rated by its possessors: and it is a salutary mortification to show that it is by no means necessary to successful practice. That, generally speaking, science is an important aid, we willingly allow: but in the highest order of cases it often operates unfavourably. By cooling down the imagination to the chill temperature of the schools, it often operates as an obstruction to a further progress, and quenches the flame of genius, which might otherwise have waxed brighter and stronger until it evented in successful invention. It is among that class of the community, for which the science of the age can hardly be said to exist, that important invention has generally arisen; and we hold it a most dangerous heresy to suppose that science must necessarily, in any material degree, heighten an engineer's proficiency, or accelerate the progress of engineering skill.

We cannot dwell longer on this subject at present, but shall probably return to it on an early occasion. We trust the College for Civil Engineers will, by the achievement of still further improvement, render itself all that the country wants, and that its well-wishers could desire. Should no improvement take place, we shall undertake to point out how a new institution may be formed for the instruction of young engineers; but we trust the task will be unnecessary, and that this College, by the adoption of further improvement, will make praise needless, and censure unavailing.

Art. III.—THEORY AND PRACTICE OF SHIP-BUILDING.

Treatise on the Theory and Practice of Naval Architecture; being the article 'Ship-building,' in the seventh edition of the Encyclopedia Britannica. By Augustin F. B. Creuze. Edinburgh: Adam and Charles Black. 1841.

This work has been sufficiently long before the public to have taken the position due to its merits, and is, consequently, very independent of any opinion we might presume to pass upon them. Public opinion is a tribunal superior to that of the critic, and one by which the soundness of his own opinions must ultimately be tested; and an author who has secured *its* favourable verdict may well be indifferent to every other. Although, therefore, we may pretend to determine the value of all fresh claims upon the public admiration, our function may be thought superfluous when judgment has already been pronounced by a higher authority. We would beg leave to insinuate, however, that even in such a case, the office of the critic may not be without its value in pointing out the qualities, by virtue of which, or in spite of which, an author has failed or succeeded. Many of the readers of such pages as ours, are necessarily uninstructed and injudicious, and will often award praise where it is least merited, and mistake imperfections for excellence.

We are not disposed, however, to rest much upon these reasons, in extenuation of a criticism so widely retrospective, as we have a better excuse in the conviction that a large proportion of our readers know nothing of Mr. Creuze's book; and that it is therefore as new to them as if it came from the press only yesterday. We are also moved by another reason, which it may perhaps be best to confess; we desire to have a general outline of the art of ship-building in our pages, according to which our future expositions respecting that art may be suitably arranged and filled in, and the review of Mr. Creuze's book furnishes a good apology for so elementary a performance.

Our opinion of Mr. Creuze's treatise is, on the whole, a favourable one; it is a clear, practical, and well-written work; and constitutes a compendium of ship-building science, which every artizan interested in that department of production should not merely possess, but comprehend. Mr. Creuze, however, falls into the very common error of unduly exalting science, and appears to think, that an acquaintance with certain geometrical problems constitutes the substance and summit of ship-building proficiency. Now, it is notorious that science has never yet achieved any improvement worth mention in naval architecture, while *taste* has achieved a great many, and is making daily additions to the number. The wherry of the Thames watermen, the canoe of the South Sea Islander, and the river steamer of the Clyde—the forms of all these are beautiful; but in the developement of these forms science has had nothing whatever to do, and they have one and all grown out of the divine instincts of uninstructed nature. In short, it appears to us, that ship-building in all its higher components has a much closer affinity to the elegant than the scientific arts, and the most admired and eligible forms have almost in every instance been the production of those who make no pretensions to scientific proficiency.

We do not, however, maintain that science may not be of use to the ship-builder, or that it is not worthy of his attention. On the contrary, we are persuaded that a certain amount of science will be found of the most essential service; and is, indeed, almost indispensable. For example, he ought to be able to determine the immersion, centre of gravity, stability, and other similar elements by scientific methods. But it is on the cultivation of his taste that the ship-builder should chiefly rely, as the means of carrying him on to eminence. Mr. Creuze tells us, that ship-building should be cultivated as an inductive science; and to a certain extent we agree with him, for ship-building is to a great extent merely mechanical. The fastening and distribution of timbers, the dimension or material proper for particular parts, the area of sails, the position of masts, all these things must be regulated by the conjoined operation of science and experience. But the qualities of symmetry, grace, and beauty, no science and no experience can impart; and, therefore, as regards these characteristics, ship-building can no more be an inductive science than poetry or painting. The beauty, in fact, of a ship, as of everything else, is a reflection merely of the intellectual condition of the producer, and where taste and sensibility are wanting in the individual, there cannot be beauty in the product. It ought to be needless to guard this language against the objection, that a person of no taste may produce beautiful vessels, by servilely copying the beautiful vessels of others; in such a case the production is manifestly not his own.

The state of the naval architecture of England has never yet been answerable to the proud position she occupies among seafaring nations. The ships of France and Spain have long been superior in many respects, and of late years the vessels of the United States have entirely taken the lead of English vessels. These effects are probably chargeable in a great measure upon the narrow policy that has long been prevalent in our dockyards, in endeavouring to keep the knowledge we possess of ship-building a profound secret—a policy by which all discussion and improvement has necessarily been arrested. Mr. Creuze makes some very judicious observations on this subject, which we here transcribe.

> "It has not unfrequently been objected to works having for their object the diffusion of information on naval improvement, that we, as Englishmen, should be cautious in publishing such knowledge, but should rather endeavour secretly to avail ourselves of it, because an opposite course might tend to diminish the superiority of our navy, by increasing the efficiency of that of our rivals. We do not believe that this conclusion is at all correct, and we shall presently endeavour to establish the position we thus assume. But even were it absolutely and incontrovertibly correct, it can only be applied to the question of the improvement of naval architecture, by the advocates of a most selfish and narrow-minded policy. A broad distinction should be drawn between the means of preservation and the means of destruction. The means of preserving human life should be considered the common property of all mankind; the means of destroying it, unless the national safety should demand it, a secret neither to be divulged nor used. Every man who can in any way add to the security with which the sea may be navigated, is as much bound to diffuse such knowledge, as he would be to save a drowning man from the waters. Whether the additional security be attained by the improvement of the chart, which is the guide to navigation, or of the chronometer and sextant, which render that guide available, or finally of the ship itself, the additional security is a boon to mankind, and the promulgator or the inventor of the means by which it is attained is surely a benefactor to his species; because, in proportion as the means and aids of navigation are perfected, its dangers are diminished, and in proportion as the knowledge of the methods for improving them is diffused, so is the whole family of man benefited, and the natural state of society, which must be presumed to be a state of peace and good-will, ameliorated.
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> "On the other hand, as far as the question of state-policy is involved, it should be remembered, that although we may avoid the discussion of questions on the improvements of naval architecture among ourselves, we cannot prevent other nations from discussing them; the necessary result of which would be, and we may almost say has been, because, to a certain extent, this policy had been pursued in England, that they would progressively improve, while we should be confined to the slow and uncertain developements of knowledge, which are the necessary consequences of being restricted within the bounds of an ever-commencing, because an uncommunicated, or, at the best, an imperfectly communicated experience. It may be said that we can profit by their advance; but is this assumption correct? If foreign nations follow that more enlightened system of policy which encourages the application of other and more abstract sciences to the investigation of the phenomena of naval architecture, and are thus able to arrive at and to establish correct conclusions, to be transmitted as sure bases for further researches, while we, on the contrary, remain ever restricted to that modicum of knowledge, or of experience, as it is called, which is the result of a lifetime of error, how are those men to be formed who would be capable of profiting by the advance made by the foreigner? Where are those men who can even be fitted to comprehend in what it consists sufficiently to render it available to our wants? Be this as it may, it is too notorious, that during our wars with France and Spain, we have never yet been able to derive the advantage of any considerable increase to our knowledge in the principles of designing ships, from the numerous fleets which have fallen into our hands, although it is equally notorious that their ships were superior to our own. The excitement of emulation is deadened in the mere copyist, and one of the chief incentives to improvement is lost in the servile office of imitation."

Another hindrance to our improvement in naval architecture is the absence of any record of the experiments which have been at various times made; and these experiments have, consequently, often been repeated after some years, under precisely the same circumstances—involving, of course, a great expenditure. Thus lead sheathing for ships has been tried a great number of times, and, after a year or two of service, has in every case been removed—to be re-applied, however, in the same manner, after the previous trial had been forgotten. A vast deal of money has thus been squandered in costly and useless trials, all of which might have been saved, or have been directed to the achievement of useful improvement, had some record existed of the occurrence and causes of the previous failures.

During the war, the inferiority of the English to the French and Spanish vessels became strikingly apparent; and, in the year 1811, a School of Naval Architecture was established, with the view of raising up a more intelligent class of shipwrights. This school was abolished in 1832, having altogether failed in achieving the desired object. Mr. Creuze, who was a member of this school, accounts for the failure, by saying that the students of the school had not fair play, being looked upon with an evil eye by the authorities of the several dockyards, who prejudiced the Admiralty against them. In our eyes the failure arose from much more obvious causes; and we think nothing can be more preposterous than to expect that the circumstance of whipping a little geometry into a few school-boys should be capable of exercising a marked influence on the great marine of a great nation. The most distinguished philosophers, both of this and other countries, have given their attention to the improvement of the form and structure of ships, without having been able to achieve a single improvement of moment; and where the masters of science have so signally failed, we can hardly anticipate much improvement from the tyros. Latterly Mr. Russell has pretended to have made great discoveries in wave lines—the adoption of which in vessels, will, it is alleged, be productive of great amelioration. These lines have, we understand, been applied in some of the West India Mail steam vessels; and those vessels are, consequently, considerably worse than the ones constructed on the common principle. This is the last improvement, and, like all the others proceeding from the same source, will, no doubt, end in a bottle of smoke.—It is time, however, to take a closer survey of the subject before us.

The immersion of a ship is only another name for her weight—the weight being just equal to the bulk of water the ship displaces. When the weight and form of a vessel, therefore, are known, it is easy to compute the quantity of water she will draw. Many rules have been given for facilitating these computations: the nature of the more important of these will be made manifest by the following quotation:—

> "Atwood gives eight theorems for measuring curvilinear spaces, two only of which are necessary for the purposes of the naval architect. The first of these is applicable when the number of equidistant ordinates is odd. It is founded on the assumption, that each portion of the curve which passes through the extremities of three successive ordinates is a part of a conic parabola, and that the first of the three ordinates of each succeeding portion is the last of the three ordinates of the preceding portion. It is not necessary in this article to prove the correctness of these rules; it is sufficient to describe their application to the subject of the article.
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> "The first rule is as follows:—Measure the lengths of all the equidistant ordinates. Take the sum of the extreme ordinates, then take the sum of the second, fourth, sixth, or even ordinates, and multiply it by four; and then take the sum of the remaining odd ordinates, or the third, fifth, &c., and multiply it by two. To the sum of these two products add the sum of the extreme ordinates, and multiply this sum by one-third of the common interval between the ordinates; the result will be the approximate area required.
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> "The second rule, which is frequently useful, is applicable when the number of ordinates is one greater than a multiple of three. It is founded on the assumption that each portion of the curve which passes through the extremities of four successive ordinates is a part of a cubic parabola, and that the first of the four ordinates of each succeeding portion of the curve is the last of the four ordinates of the preceding portion.
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> "This rule is as follows:—Measure the lengths of all the equidistant ordinates. Take the sum of the extreme ordinates, then take the sum of those remaining ordinates which are one greater than a multiple of three, as the fourth, seventh, tenth, &c., and multiply it by two; and then take the sum of all the remaining ordinates, and multiply it by three. To the sum of these two products add the sum of the extreme ordinates, and multiply this sum by three-eighths of the common interval between the ordinates; the result will be the approximate area required."

By these rules the areas of the vertical, transverse, and horizontal sections may be easily computed; and the lines being given, the cubical content of the immerged portion of the ship may at once be ascertained. The immerged content in cubic feet multiplied by the weight of a cubic foot of water, will of course give the weight of the ship; or, conversely, the weight being given, the immerged content answerable to that weight, or, in other words, the draught of water, becomes easily determinable.

In order that a ship may swim on an even keel, the centre of gravity of the displacement and the centre of gravity of the ship herself must be in the same vertical line. The computation of the exact position of the centres of gravity is a very tedious matter, and is very seldom performed. Mr. Creuze gives the following explanation of the mode of accomplishing the desired end by approximation:—

> "If perpendiculars be drawn from any number of bodies to a given plane, the sum of the products of each body, multiplied by its perpendicular distance from the plane, is equal to the product of the sum of all the bodies multiplied by the perpendicular distance of their common centre of gravity from the same plane; and also of its corollary, that if any of the bodies lie on the other side of the plane, their distances must be reckoned as being negative. In applying this theorem to find the centre of gravity of any curvilinear space, by the application of either of the before-mentioned rules of approximation, each ordinate must be multiplied by its perpendicular distance from some given line, usually in a section near one of the extremities of the vessel: these products are then used as ordinates, and the rule is applied, and the calculations made, in the same manner as for finding the area of a space, the result, however, being the moment of the space. The moment of the space on the opposite or negative side of the line that was assumed from which to measure the perpendicular distances of the ordinates, is calculated by the application of the same means if the area be large; if small, a more simple method will easily suggest itself, and the moment thus obtained is subtracted from the former moment; the remainder is the total moment of the space, estimated from the assumed line, and this, divided by the total area of the same space, will give the distance of its centre of gravity from the assumed line. In this manner the centres of gravity of the load water-section and of the midship section may be found.
>
> "The position of the centre of gravity of the displacement is found by the application of the same rule of approximation. In order to determine its vertical distance below the load water-section, a series of equidistant horizontal sections must be drawn; then the area of each successive horizontal section is multiplied by its perpendicular distance below the load water-section, and these products are used as ordinates in either of the rules. The result is the moment of the space between the load water-section and the lowest horizontal section; to this must be added the moment of that part of the body which is below the lowest horizontal section. This will be obtained by multiplying its solid content into the vertical depth of its centre of gravity below the load water-section; the sum of these two moments is the moment of the whole displacement, estimated from the load water-section; and this moment, divided by the total displacement, will give the vertical distance of its centre of gravity below that load water-section. The position longitudinally of the centre of gravity of the displacement is obtained in a similar manner, by calculating the moment of that part of the displacement which is situated before some one of the transverse vertical sections, and also the moment of that part of the displacement situated on the opposite or negative side of the same section; then subtracting the negative moment from the positive, the remainder, which is the moment of the whole displacement estimated from the assumed vertical section, divided by the total displacement, will give the distance of its centre of gravity from the assumed vertical section."

Should these centres of gravity, when ascertained, not be such as is requisite for the trim and stability of the ship, such alterations must be made in the design as will bring the problem under more favourable conditions for the attainment of the desired object.

The next point to which we must direct our attention is the rolling action of a ship in a sea-way, or, rather, the connexion between that action and the shape of the ship. When a ship rolls, a certain portion of the side above the water-line becomes immerged in the water, and a certain portion of the other side is raised out of the water; and the forms of the immerged and emerged portions will materially influence the easy motion of the ship. As the immerged and emerged portions are not necessarily of the same shape, their centres of gravity may not be in the same vertical section; and each roll of the ship may, therefore, at the same time tend to slue her round, which will give a very uneasy motion. It is important, therefore, that the centres of gravity of the immerged and emerged portions should be in the same vertical plane, so that the ship may roll on a fixed axis parallel to the keel, and not on one which is perpetually forming angles with the keel first on the one side and then on the other. This end will be attained if any fulness or attenuation be gradual and regularly diffused; but if there be any sudden indentations or protuberances at or about the water-level, the vessel will have a perpetual tendency to vibrate around a vertical axis—a motion both injurious to the ship and unpleasant to its occupants.

But it is not merely in slueing the ship that the solids of immersion and emersion may have an evil effect from their defective form: they may also raise or lower the centre of gravity of the ship with much suddenness, and make the motion uneasy from this cause. This will be the case when the side of a ship flams out very suddenly: the inclined side arrests the rolling motion abruptly, and the ship actually rises on the wave as on a fulcrum, communicating at the same time a very unpleasant motion, and seriously racking the ship. In some of the older class of steam vessels which have large overhanging sponsons, the evils due to this malformation have been conspicuously manifested. It is almost impossible, in some of them, to keep the sponsons tight; and the lash of the waves against the sponsons gives the same sensation to the persons on board as if the ship were beating on a rock.

The *metacentre* is a term of frequent use in naval architecture, though its exact import is not very well understood even by many who have it often in their mouths. It is a point in the cross-section of a ship indicative of the ship's stability, and is, in fact, that point below which the centre of gravity of the ship must be placed in order to prevent her from tumbling over. Before the metacentre can be found, the centre of gravity of the displacement must have been computed: that done, the metacentre may be found as follows:—

Take a cross section of the ship: draw a line across it for the water-line, and mark with a dot the centre of gravity of the displacement, which will of course be amidships. Suppose now the ship be inclined with any small angle to the horizon: draw another water-line representative of this inclination, cutting the first water-line amidships, and mark with another dot the position the centre of gravity of the displacement will now have assumed. From these two dots draw two lines at right angles to their respective water-lines: one of these lines will of course be upright, and the other will not be so: the point where the two intersect is the metacentre.

We have now, then, explained the three most important scientific determinations of a ship—the way of finding the centre of gravity of the ship, the centre of gravity of the displacement, and the metacentre. We cannot pursue the subject further at present, but shall probably in our next Number explain the way of laying ships down, and may also say something on the subject of scantlings.

Art. IV.—THE FACTORIES OF LONDON.

Days at the Factories, or the Manufacturing Industry of Great Britain described. By George Dodd. London: Knight and Co., 1843. (Second Notice.)

We spent eight days with Mr. Dodd at our last interview, and we now purpose to accompany him to the remainder of his places of visitation. Of these, the next in order is the Soap and Candle Works of the Messrs. Hawes, at the Surrey end of Waterloo-bridge. Mr. Dodd's description of the operations of this factory is the very worst he has hitherto indulged us with. It is confused, prolix, and trifling, and, we fear, will defy all endeavours of ours to turn it into a tolerable narration. We must, however, try what can be done, and are confident that no animal except a reviewer could be induced to attempt so toilsome a transformation.

The varieties of hard soap are, the white, the mottled, and the yellow; and all these are chiefly composed of tallow and soda. Soft soap, again, is composed for the most part of oil and potash. The composition of the white and mottled soaps is almost identical; but yellow soap contains, in addition to tallow and soda, a large proportion of rosin and palm oil, to which admixtures its peculiar qualities are due. The tallow used in soap making is for the most part brought from Russia; in the coarser kinds of soap, however, a considerable proportion of the fatty refuse of cookery, called "kitchen-stuff," is employed, after having been first purified from all foreign admixtures. This substance serves the place of tallow, but is not so good.

The soda used in soap making is now derived almost exclusively from the decomposition of common salt. By treating common salt with sulphuric acid, muriatic acid gas is disengaged, and sulphate of soda obtained. The sulphate is converted into the carbonate of soda by association with carbon, and, finally, the carbonic acid is extracted, leaving a pure caustic soda. Out of this caustic soda the leys are made, which, by being boiled with the tallow, produce soap. In former times, the alkali for soap making was obtained from *barilla* or from *kelp;* but the use of those substances to any considerable extent has now become obsolete, and the trade in those articles has consequently dwindled into insignificance. The production of soda from common salt is one of the most important discoveries of the present time.

The most important operation in soap making is that of boiling the tallow with the ley or alkaline solution. This is accomplished in great cast-iron boilers heated by steam, in most of the modern factories, though in many places the boiling is still performed over a fire. To each boiler appropriate conduits are attached for the conveyance of the alkaline liquor from the vats wherein it is prepared, and also a pump for pumping up the ley from beneath the soap. The ley, when its alkaline virtue is exhausted, is pumped up and conveyed away; and the soap, after attaining a proper consistence, is ladled into frames, if hard soap, and into casks or other vessels if soft. The frames are so made that their sides are removable, leaving an oblong cube (so to speak) of soap, which is cut into wedges by a wire. The mottled soap is substantially the same as the white soap: the mottled appearance is produced by throwing a little strong ley over the surface of the boiling mass when it has nearly attained the right consistency. The ley descends through the mass of the soap in veins, and thereby gives the mottled complexion. Fancy soaps are merely common soap, to which certain perfumes and colouring matters have been added. Transparent soap is soap that has been dissolved in spirit of wine, and the spirit afterwards evaporated.

The oil used for the manufacture of soft soap is chiefly common whale oil; and this kind of soap has, consequently, for the most part, a disagreeable odour. In the Barbary states, in Egypt, the Levant, and other places, a great deal of soft soap is made of olive oil; and the smell of this kind of soap is not in the least disagreeable. Hard soap is also made very extensively out of olive oil in many of the olive growing countries. In the island of Candia this manufacture has long and largely thriven. The town of Retimo contains six, and the town of Canea eight soap manufactories, capable of producing six thousand tons of soap per annum. The soap of Candia obtains the higest price at Trieste, to which place a large quantity of it is exported.

We do not think it necessary to follow Mr. Dodd in his exposition of the internal arrangement of Messrs. Hawes' candle stores; and the process of candle making is so simple and so well known, that it would be trifling with our readers' time to enter into a long dissertation on the subject. The only expedient in candle making which occurs to us as worth mentioning, is that whereby the proper number of dips in the melted grease is ascertained, and which consists merely in so adjusting the cluster of candles to a weight at the opposite end of a weigh-beam, that an equipoise will be established when the proper number of dips has been given. This contrivance is neither novel nor recondite, but is a good, plain, common-sense plan. It is not, however, in universal use, though used very extensively.

The tenth day brings us to Day and Martin's Blacking Manufactory; and here, after wading through a number of pages respecting the state of shoe-blacking in the reign of Queen Anne, diversified with poetical quotations and reflections upon the impropriety of calling sealing-wax by the name it bears, when there is no wax in it, with a variety of other matters of similarly weighty import, we find that Mr. Dodd has no information to give us about blacking-making at all—except, indeed, it be the intimation that blacking is composed of ivory-black or some other black, and of oil, vinegar, and some other substances. We never saw a more notable instance of book-making than that which Mr. Dodd has here exhibited. He proses away for page after page with the most exemplary composure; and the upshot of the whole business is, that he has nothing whatever to tell us. He sets out by inducing us to suppose that we are to learn something of blacking-making; but instead of giving us any information upon that head, he puts us off with an enumeration of the skylights in Day and Martin's factory, and an account of the scrolls of their hand-railing. Mr. Dodd informs us, that in this manufactory there is "nothing very elaborate, no complicated machinery, no array of engines and machines, for making the commodity produced;" and it is evident, therefore, that, in the absence of all such mechanical appliances, the interest of such a factory must attach exclusively to the *process.* But towards the end of the article we find that of the process—the nature of the compound or admixture which constitutes blacking—Mr. Dodd acknowledges he has nothing to say. He observes, that, to the reader who expects an exposition of these matters, he must answer in the words of Scott, "we cannot if we would, and we ought not if we could." Now, we have no fault to find either with Messrs. Day and Martin for keeping their composition secret, or with Mr. Dodd for knowing nothing about it; but we really think he might have announced his ignorance at an earlier period. When he knew that he had no information to give respecting blacking-making, he should just have said so, and not have attempted to cheat us into the belief that he could in the least enlighten us on that subject.

The eleventh day brings us to the London Marble Works, situated in Esher-street, near the end of Vauxhall-bridge. The apparatus of this factory is very intelligibly described, and we shall have no difficulty in giving our readers a tolerably clear conception of its mode of action.

The first thing, on bringing a block of marble to the factory, is, to cut it into slabs. This is accomplished by a number of toothless reciprocating saws duly supplied with sand and water. These saws are fitted in a frame at a distance from each other equal to the thickness of the slabs which have to be cut, and the frame is then put in motion by a connecting rod proceeding from a crank or cam attached to some part of the machinery driven by the steam engine. The frame in which the saws are fixed is retained in the right direction by means of guides. It is manifest that the saws may either move perpendicularly or horizontally. In the factory under review the horizontal direction appears to be preferred; and the whole weight of the saw and frame is not allowed to rest on the marble, but is counterpoised by a weight hanging over a pulley, which takes off any required proportion of the weight of the saws. For cutting the slabs into strips, circular saws are employed. These saws consist merely of discs of iron fitted on a spindle, at a distance from each other depending on the breadth of the required slips. When put into rapid revolution, and duly fed with sand and water, they cut the marble very quickly. It is of course important that the sand used should be pure and sharp. A different fineness of sand is requisite for different kinds of stone. For running mouldings on the edges of slabs, an iron disc is employed, so fashioned as to produce, by the abrasion due to its rapid rotation, the required design. Small holes may be cut in marble slabs by means of a hollow cylinder of iron supplied with sand and water, acting in the manner of an upright drill, so as to make a narrow circular cut, which disengages the central piece. Larger holes are generally made by means of two cutters, fixed one at each end of a cross-arm, connected with an upright shaft; by which arrangement a circular cut may be made as before. Marble may also be turned in a common lathe, and many articles are produced by the instrumentality of that familiar mechanism.

By these means marble may be brought into any plain form, but the tool marks will generally remain on its surface; and to obliterate them, and make the surface perfectly fair, it is necessary that the surfaces should be ground. Small pieces of marble are generally ground by holding them down against a circular revolving table of iron on which sand and water have been sprinkled. Large surfaces are ground by fixing them upon a table which may be moved backwards and forwards; and upon the surface of the marble a circular plate of iron is permitted to rest, which is put into revolution by a spindle above. Sand and water are interposed between the iron and the marble, and, as the one turns round while the other is moved slowly forward, the grinding is speedily accomplished. The disparity in the motion of the centre and circumference of the iron disc is calculated, unless re-dressed, to have a prejudicial effect: the movement of the disc is, therefore, not made circular, but somewhat eccentric, so that all derangement from this source is averted.

The surfaces being made smooth and true, the next operation is that of polishing, which is effected by moving heavy rubbers backwards and forwards, the face of the rubbers being covered with a species of felt, and supplied from time to time with *tripoli* or putty-powder. These rubbers are usually moved by hand, but in this factory are moved by machinery.

Such, then, are the principal marvels of the London Marble Works. In contradiction to Mr. Dodd's dictum, we must say that the several appliances *do not* manifest any great inventive talent, for they are, one and all, merely the extension to a new manufacture of apparatus already in successful use in other analogous operations. There is not a machine in the whole of the number Mr. Dodd has described which rises to the rank of an invention, or which had not been previously applied to other branches of industry. We do not say this to disparage in any way this particular application of machinery, of the advantages and merits of which we are highly sensible, but merely to record our dissent from that vague and inordinate praise which flows from an ignorant admiration.

The next factory we come to is the Flint-glass Factory of Mr. Pellatt, situated in Holland-street, Blackfriars. Flint-glass is so termed because formerly it was made with flints, which were reduced to powder by heating, and then quenching them in water. Sea-sand, however, has been found to answer as well, and, being a more convenient material, is now generally employed. The sand used in this country for glass making is brought chiefly from Lynn, in Norfolk, and Alum Bay, in the Isle of Wight. This sand, after being well washed, dried, and sifted, is mixed with the other ingredients necessary to the formation of glass, in about the proportion of three parts of sand, two of litharge, one of carbonate and nitrate of potash, and a small portion of the oxides of arsenic and manganese. These materials being duly mixed, are placed in the melting-pots, each of which is generally made of sufficient capacity to hold sixteen hundred-weight of glass. The pots are then placed around the inner side of the wall of a circular furnace, in the centre of which the fire is placed—the whole being covered with a dome top. The flues of this furnace are so situated in the external wall, that the flame, before it can reach the chimney, has to pass between and amongst the pots, by which means the pots become quickly and intensely heated. The pots are made close at the top, and open on one side; and a ledge projects all around this opening, which protrudes through the furnace wall, into which it fits tightly. The heat, therefore, passes to the glass exclusively through the pot, and the glass is unexposed to the smoke and vapours of the furnace, by which its quality would be injured. Mr. Dodd acquits himself so well in this chapter that we must permit him to speak for himself. The following appears to us to be very tolerably said:—

> "The management of a glass-house, in respect to *time*, is somewhat curious, and worthy of note. The filling and emptying of a melting-pot are in general so managed as to occupy one week. On Friday morning the necessary arrangements for filling commence. The mixed ingredients are brought to the furnace in wooden vessels, and then thrown into the pots by means of shovels, through the openings before alluded to. About four hundredweight is put into each pot; the mouth is

closed; the fire kept burning strongly; and the ingredients allowed to sink and melt. Three or four hours afterwards, the hole is again opened, another equal supply thrown in, and another equal space of time allowed to elapse. This is repeated four times, until each pot contains its full quota of about sixteen hundredweight. When all the pots are filled, every orifice is stopped up, the fuel is urged to vivid combustion by increased draught from beneath, and the ingredients remain throughout Saturday and Sunday exposed to an intense heat. At stated intervals a small opening is made, and a little of 'the metal' (as the glass is technically termed) is withdrawn, to test its progress. In some glass-works, a considerable quantity of scum rises to the surface of the glass while melting; but there is not much in a flint-glass furnace, on account of the purity of the materials, and this little is removed by skimming. We may here observe, that, without any wish on the part of the proprietor to deviate from usual customs, a glass-house furnace must necessarily be kept heated on Sundays as well as other days; but the week is so apportioned as to leave as little as possible to be done on Sundays—nothing, indeed, but to watch the furnace, each man having three Sundays out of four at liberty.

"On Monday morning all is ready for the glass-workers; the pots are full of 'metal,' looking like liquid fire, and a large party of workmen assemble round the furnace. The mouths are opened, so as to afford access to the melted glass; and smaller holes are opened also, at which the working-tools are heated.

"Flint-glass ware, such as drinking-glasses, cruets, decanters, lustres, lamp-shades, phials, &c., are made partly by blowing, partly by manual working, and, in a smaller degree, by moulding or casting, in a way which we will endeavour to describe. We first saw some four-sided perfumery bottles made. A man took a hollow iron tube, about five feet long, and half an inch in diameter, and, dipping one end into a pot of melted glass, collected a small quantity at the extremity. The glass appeared like a projecting lump of red-hot iron, and, from its consistence (between that of treacle and of putty), was just able to be retained on the tube. He then rolled the glass on a flat plate of iron, thereby giving it a cylindrical form, and pinched a part of it, by means of a small instrument, to form the neck of the bottle. He next inserted the end of the tube into a small brass mould lying on the ground, shut up the two parts of which the mould consisted, and blew through the tube. This double operation produces a curious effect; for while the air from the lungs, passing through the tube, makes the mass of glass hollow, the mould at the same time imparts to it the external form required. The mould being opened, the glass—now in the form of a bottle—was withdrawn, still adhering to the end of the rod, and was detached by a slight touch with a piece of cold iron. All this was done in about half a minute; and during the latter part of the process another workman was gathering and rolling a similar portion of glass, so that one mould served for both. As the bottles were severed from the tube, they were taken up on the end of a heated rod by a third workman, who re-heated them (for by this time they were below red-heat), and by means of a few simple tools finished the necks and mouths as fast as the other two could make the bottles."

All glass articles, after being made, are annealed by being heated to a high temperature in a furnace, and then suffered to cool by slow degrees. Without annealing, glass articles would be too brittle for use. The time requisite for annealing varies from twelve to sixty hours.

It is an object of the utmost importance in the economy of a glass factory, that the pots in which the glass is made should be of the best quality; for if they crack frequently, not only is a great loss sustained in glass, but a derangement is cast over the operations of the factory. The utmost care is therefore taken in the preparation of the melting-pots. The best Stourbridge clay is the material out of which the pots are made in combination with pieces of old pots reduced to powder. Four parts of new clay are used to one part of old pots; the ingredients are ground together to a powder in a mill, sifted, and then kneaded together by the tramp of naked feet. Out of the substance thus prepared the pots are made. One man will make four pots in a week. A good pot will last in the furnace from two to three months.

The ductility of glass at a certain temperature is probably greater than that of any other substance whatever. This is very strikingly shown by the fineness of the threads into which it may be drawn; though still more so, perhaps, by the length to which a glass tube may be drawn out without in any way changing the shape of the bore. The bore of thermometer tubes is generally made not cylindrical but elliptical—the object being to make the mercurial column as visible as possible from the front, without the necessity of enlarging the bulb. This is effected by making a flattened hole in the primitive tube, and then drawing it out, by which means its calibre may be diminished to any required extent, the shape of the central channel remaining unaltered.—The following we cannot improve, and therefore give it as it is:—

"The most profitable and important articles of flint-glass are such as are largely employed and have a current sale; but the costly and delicate articles occasionally produced call for great skill and inventive ingenuity. There is a kind of cut-glass in which the projecting parts of the pattern are coloured, and the sunken parts colourless. These are produced in a remarkable way; for after the working-tube has collected nearly sufficient colourless glass from one pot, the mass is dipped into another containing glass which is coloured by the addition of certain metallic oxides, by which an external coating of coloured glass is given to the mass. When the blowing and modelling are completed, this exterior coating is, in the finishing process of cutting, ground away in some parts and left remaining in others, thus producing a singularly delicate effect.

"Another kind of ornamental manufacture is the 'crystallo-ceramie,' or glass incrustation, patented by Mr. Pellatt some years ago, and consisting of an opaque substance imbedded in a mass of colourless glass. A medallion or bas-relief, representing any device whatever, is moulded in a peculiar kind of clay capable of resisting the heat of melted glass; and the medallion is enclosed between two pieces of soft glass, or else is introduced into a cavity in the glass, from whence the air is afterwards extracted. The introduction of the medallion into the glass is the main difficulty in this process, and requires much skill and ingenuity, in order that no air-bubbles may exist between the two substances. When finished, and the external surface of the glass cut to the required form, the appearance of the imbedded medallion is singularly chaste and elegant; for the white clay, seen within the clear and highly refractive glass, presents an appearance nearly resembling that of unburnished silver. This branch of art, that is, the incrustation of clay devices, was invented by a Bohemian about sixty years ago; at a later period some French manufacturers incrusted medallions of Napoleon in this way, and sold them at an enormous price; but since the introduction of the art into England, under an improved form, a wide extension has been given to its applicability. Decanters, goblets, wine-glasses, lamps, girandoles, chimney-ornaments, plates, door-handles, and other articles formed of flint-glass, have been ornamented in this way; the incrustations being arms, ciphers, crests, inscriptions, portraits, small busts, caryatides, or indeed any small objects capable of being modelled or moulded in clay. The incrustation may be painted with metallic colours, which will remain uninjured by the heat required in the process.

"There is a mode of incrusting opaque ornaments or devices on the surface, instead of within the substance, of the glass. This is effected by adjusting the ornament in a brass mould, and blowing and moulding the glass to it; the details requiring considerable skill, but the principle being nearly the same as in the other process.

"The astronomer and the optician obtain from the flint-glass manufacturer the materials from which their lenses are made. It has been ascertained that there is a certain state of the fused glass which is best calculated for optical purposes; and when the mass has attained this state, about seven pounds weight is taken up in a conical ladle and blown into the form of a hollow cylinder. This cylinder is cut open, and flattened into a sheet twenty inches long by fourteen wide, and from two to three eighths of an inch in thickness. In this form it passes into the hands of the optician, who cuts and grinds it to the shapes required for optical purposes. The masses of glass for large telescope lenses require a somewhat different process, and extraordinary care in the choice, preparation, mixing, and melting of the ingredients: indeed, the production of good glass for this purpose is one of the most uncertain things in the whole glass manufacture."

Turn we now to the Floor-cloth Manufactory of Messrs. Smith and Baber, at Knightsbridge, to ascertain the nature of the operations carried on there. The first thing in making a piece of floor-cloth is, to stretch the canvass on a perpendicular frame. This is accomplished by rolling the canvass very evenly on a roller, hoisting the roller to the top of the frame, and then permitting it to descend slowly like the drop-scene of a theatre, while one end of the canvass remains fixed above. The canvas is then fixed to the frame, and, finally, two sides of the frame, which are made moveable, are forced outwards by screws, so as to make the canvass very tight. The canvass next receives a coat of size, after which it is rubbed down with pumice-stone, and is then ready for the paint.

The paint used for the manufacture of floor-cloth is just common paint, with the exception that it is thicker than usual, and has no turpentine in it. The back of the floor-cloth is the side first painted, and the first coat is so thick that it requires to be spread evenly by a trowel. Dabs of paint are put upon the canvass with a stiff, short-haired brush, and, by means of a long conical trowel, they are equally distributed over the surface, and fill the indentations of the canvass more effectually than if the paint were laid on in the common manner. This coat of paint requires from ten to fourteen days to dry, and at the end of that time another coat of paint is given, but *it* is laid on with a brush in the ordinary method. This coat is thinner than the other, and does not take so long to dry.

The face of the cloth has as yet had nothing done to it. It now receives a coat of size, and is pumiced down. It then receives three successive trowel coats, being pumiced between each, and, finally, a brush colour is given. It is then ready for being printed. The printing is accomplished by means of wooden blocks, of which one is required for each colour in the pattern. Each printer has a pad beside him, covered with the colour he is using, and on this he dabs the block, and then applies it to the oil-cloth, forcing it down each time with a heavy hammer. The cloth, as it becomes printed, descends through a slit in the floor to the place where it remains until completely dry.

The next day, which is spent at a Clock-maker's, is a bad one. Mr. Dodd has little to say upon the several operations that is of the least interest or novelty; and several of the resources he mentions with approbation are not of the best description. He gives an account of an antiquated engine for cutting the teeth of wheels, and pronounces a useless exordium on the accuracy requisite for such machines, and the accuracy of which they are productive. The day at the Printing-office is much better, though the familiarity of the operations of the printer to most persons, may, perhaps, deprive this chapter of some of the interest to which it is justly entitled. The same remark applies to the day spent at a Bookbinder's. In fact, the establishments of printers and bookbinders can hardly be termed *factories*, and want both the zest of novelty and of refined or complex mechanical application which attach to more surprising establishments.

The seventeenth day brings us to Messrs. Broadwood's Pianoforte Factory, which is very well described: the eighteenth day to the Westminster Gas Works: and the nineteenth to the Coach Factory of Messrs. Pearce and Countze, of Long-acre. From the description of the last of these places our readers may take an extract:—

"The experience and tact requisite for this department of coach-building have the usual effect on the relation between master and workman. The rate of wages is as high, we believe, as from three to five guineas per week. Coach-body makers, indeed, rank among the highest order of London artizans: the number of first-rate workmen in that branch is limited, and does not appear likely to increase in any great degree.

"The reader will then understand that the *body* of a carriage, *i. e.* that part in which the sitters are placed, is made by a class of workmen different from those who make the under part of a carriage; that the wood of which the body is principally formed (in the larger and more important factories) is principally ash and mahogany; that the workman fashions the various pieces by the aid of a pattern-board, as in the process of ship-building; that the actual process of working the wood is a superior kind of joiner's work; and that the operations are conducted in that floor of the building called the 'coach-making loft.' While the body of a coach is thus in the process of formation, the other parts are being made by other sets of workmen; the 'carriage-makers' are employed on the complicated mechanism beneath the body; the smiths are preparing the numerous pieces of iron required in various parts of the coach; and the wheelwrights are making the wheels. Perhaps we may as well introduce in this place the few observations we have to offer on the subject of wheel-making. The business of a wheelwright is totally distinct from that of a coach-builder; no establishment of the latter kind, we believe, being in the habit of making the wheels for their own coaches. But we think it desirable to put our coach upon wheels before presenting it to the reader; and shall therefore briefly describe the operations of wheel-making as carried on at the extensive manufactory of Messrs. Curll and Glover, Sutton-street, Soho.

"A coach-wheel is a remarkable instance of lightness combined with strength; and not less remarkable for the accuracy of hand and eye required in its construction. As a matter of principle, a large flat circular piece of wood, with a hole in the centre, would form a wheel, and in many countries forms the only kind of wheel used at the present day; but practice shows that a much smaller quantity of material is capable of being wrought into a wheel excelling not only in elegance, but also in durability, such rude productions. The essential parts of a modern wheel are the *nave*, the *spokes*, and the *felloes*, corresponding to the centre, the radii, and the circumference of a circle. The nave is a short block of wood, usually elm, forming the middle of the wheel, and pierced with a hole to receive the axle or axle-tree. The spokes are bars of oak, radiating from the nave at equal distances one from another, and extending to equal distances from the nave. The felloes are circular segments of ash, framed on the extremities of the spokes, and joined one to another so as to form a circle. To these parts must be added the *tire*, an iron hoop which binds all the felloes closely together."

The coach manufacture is still in a state of great rudeness in many respects. The wheels, perch, and many other parts now made of wood, might, no doubt, be made of iron, with much advantage both in point of lightness as well as in that of cheapness and durability. Such improvements, however, are not likely to be carried into effect by the present race of artizans, who are wedded to the existing system, and will not believe that it is otherwise than perfect. Some light may, perhaps, be let in upon the orthodox makers by the heretic race of railway-carriage makers, whose tenets are necessarily uninfluenced by precedent, and who have not evinced any great anxiety to be ruled by the devices of our grandfathers.

Mr. Dodd's last days are spent at a Ship-yard and Lead Factory, the operations of which he describes with much minuteness; but his expositions of these operations are too elementary, perhaps, for our pages, even if we were able to find room for their introduction. The ship-yard described is that of Messrs. Wigram and Green, and the lead works those of the Messrs. Poutifex. These descriptions were all, we believe, originally printed in the "Penny Magazine," though now for the first time given to the world in a collected form.

We cannot part with Mr. Dodd without giving him a few words of advice, should he be intent on committing any more descriptions, as we believe the case to be. Let him then, for the future, go to the point at which he wishes to arrive at once, without indulging in any long preambles respecting the history or importance of the particular manufacture under review. Let him also avoid all minute details respecting the internal arrangements of the place, which are the result merely of accident or situation, and which are in no wise essential to the manufacture carried on. No one whatever cares whether a certain stairs turn to the right or to the left, or whether a certain room has six windows or five. He should first, in all cases, describe the general nature of the process, and then the nature of the apparatus by which it is carried on. By taking the opposite course to this, he will, of necessity, be unintelligible to many readers, unless they read the book in an inverted order. Finally, he should make a vow never again to be needlessly long-winded: the less the number of words in which any given operation can be clearly described, the more valuable must that description become; and Mr. Dodd's book would have been two-thirds better had it been condensed into one-third of the size.

ART. V.—ON HARMONY OF FORM.

The Natural Principles and Analogy of the Harmony of Form. By D. A. HAY. Edinburgh: Blackwood. 1842.

THE object of this work will best be explained by the following extracts:—

"There can be no doubt that the effect produced by the harmony of sound, colour, and form, are equally the result of a susceptibility of the human mind, which renders it capable of appreciating an adherence to certain natural principles by which harmony in every case is produced. These principles are clearly understood in regard to the harmony of sound, from its having occupied the attention of the most eminent natural philosophers in all ages. Colours, likewise, since the discoveries of Sir Isaac Newton, have in their combinations been reduced to something like system. But the harmony of form has heen left out of those enquiries, as a matter depending upon opinion alone, unless in regard to architecture, where the works of the ancients have in some measure supplied the want of general principles.

"As a knowledge of the natural principles which regulate the arrangement of musical sounds tends to improve the general understanding and practice of that particular art, without producing a musical ear, or enhancing the pleasure derivable from an intuitive perception of 'the melody of sweet sounds;' so may a knowledge of the natural principles of harmony in form improve our judgment in architecture, sculpture, and painting, without rendering us fit to follow any of those arts as a profession, or enhancing the pleasure conveyed to the mind by the visual organ.

"A person is said to have an ear for music, in the ratio of the sensibility of that organ to the relative gravity and acuteness of sounds; and when this is accompanied by an intuitive appreciation of the natural principles which regulate their combination, he will, according to the extent of this talent, have a genius for musical composition. So, likewise, in the ratio of the sensibility of the eye, and intuitive appreciation of the natural principles of form, will an individual possess a facility in producing harmonious arrangements, independently of any other knowledge of these principles. Thus works of art in all ages have occasionally displayed the most perfectly harmonious combinations of form. These are, however, of rare occurrence, being the works of men of great genius; and although they may be models for the careful study of those who follow such arts professionally, they cannot supply the place of natural principles in forming the public taste. Had the arrangement of musical sounds depended, like that of forms, upon the works of the ancients, without a knowledge of the natural principles upon which the excellence of these works depends, music could not have become a part of polite education."

We have no hesitation in dissenting altogether from Mr. Hay on these subjects. His analogies are very loose, and often very fanciful, and his arguments are often, indeed generally, devoid of philosophical consecution. Our conviction is, that the pleasure derivable from musical harmony is chiefly sensual, and that there is no connexion between this variety of beauty and that due to agreeable forms which operate on the principle of association. In short, we look upon Mr. Hay's theory as a preposterous one, and the way in which his book is got up is quite as preposterous. There are only a few lines of letter-press in each page, the far greater part being margin.

ART. VI.—ELECTRO-METALLURGY.

IT has long been known to men of science, that when a current of electricity is made to pass through a metallic salt in solution, the salt is decomposed—the metal passing to the negative, and the acid or solvent to the positive pole of the battery. After the invention of the Constant Battery, by Professor Daniel, the existence of a metallic deposition upon the copper, or negative cell of the battery, was observed by numerous persons; and Daniel, Becquerel, and others observed that, when these deposited metals were detached from the cell, they bore exact counter-impressions of any marks or scratches which had been made upon its surface. These philosophers, however, do not appear to have perceived the applicability of this peculiarity to practically useful purposes. The first attempt to carry the principle thus accidentally discovered into beneficial use, was that of Messrs. Elkington and Barratt, in the art of electro-plating, for which they obtained a patent in 1838. In a dilute solution of muriate of zinc, pieces of zinc were placed; the articles to be coated were then immersed in the same solution at a boiling heat, and being made to touch the pieces of zinc, a battery was formed between the zinc and the articles, which consequently became covered with a coating of zinc.

It was not, however, until Mr. Spencer read his memorable paper upon the subject of electro deposition, to the Liverpool Polytechnic Society, that the public became alive to the importance of the application. The publication of that paper acted like a spell upon the public mind, and few months elapsed before almost every school-boy who could furnish himself with a piece of zinc and copper and a common garden-pot became an electrotypist. It is the property of some minds, however, rather to discover than apply, and many whose names are enshrined in discoveries as brilliant as that which will transmit the name of Spencer to future ages, have failed or neglected to make their discoveries subservient to useful purposes. Genius will sometimes pause in its career, from the conviction that it has already achieved immortality, and from the want of the stimulus of such difficulty as is unsurmounted by inferior spirits. It appears, moreover, that those qualities which dispose and fit a man to invent, indispose and unfit him in a great measure to improve. In invention, the imagination is the faculty most exercised; and in improvement the judgment: in invention no great prominency can be given to the determinations of experience, or to the technicalities of existing modes or processes; whereas, improvement must have reference chiefly to these accidental conditions. In short, it appears very plain, that invention and improvement are to a certain degree antagonist forces, though generally they more or less work in unison; and such diverse exercises require a different mental constitution for their successful prosecution.

But, however this may be, it is at least certain, that while to Mr. Spencer belongs the merit of being at least one of the inventors of the method of electric deposition, he never brought the process to any great practical utility so far as regards plating. Thus, in 1840, two years after his discovery, in a pamphlet he then published, entitled, "Instruction for the Multiplication of Works of Art in Metal," he answers many applications which had been made to him about depositing other metals besides copper in the following words:—"As might be expected from the numerous experiments made, and the length of time I have been engaged in them, I have almost necessarily attempted to apply the electro chemical process to nearly all the solvent metals, including gold and silver. The results have not yet been made public, nor the particular modifications of the process, for the simple reason, that nothing has been done which I conceive might be applied *usefully* or *profitably*."* It appears, moreover, that his anticipations of such an application being made at some future time were by no means very sanguine. He says, "I do not think that the voltaic method of gilding will supersede that already in use, unless the process be still further improved." Five months, however, previous to this time, the Messrs. Elkington had obtained a patent for plating and gilding by galvanic action, by which a useful result was realized. In this patent several solutions of gold and silver were specified, as having been used, but preference was given to the cyanides of gold and silver, dissolved in the cyanides of potass; and though many improvements in detail have since suggested themselves, the process is still substantially the same as there marked out, and these are the only solutions which have as yet perfectly succeeded in the art of plating and gilding. The method of preparing the solutions is fully detailed in the specification.

As might have been expected, many other patents followed that of Messrs. Elkington, none of them touching the *principle* of electro-deposition, and differing only from that of the Messrs. Elkington in the particular salts or solutions they recommend to be used. The first after Messrs. Elkington, which has any reference to silvering and gilding, is that of Mr. Spencer, in 1841, in which he recommends the dissolution of silver or gold in bromine or iodine; but, so far as our experience goes, we believe this plan is of little practical utility. The next is a project by Parkes for depositing silver and gold in moulds, which may be removed by heat or otherwise from the deposited metals, and by this means articles of solid gold or silver are obtainable.

In 1842, Mr. Talbot obtained a patent for certain improvements in this art, which consist in the use of gallic acid dissolved in alcohol, mixed with the silver solution. He also claims as a novelty the preparation of a silver solution, by dissolving freshly precipitated chloride of silver in hyposulphate of soda, or any other liquid hyposulphate. In the same year, Dr. Leeson took out a patent, which specifies the use of almost every conceivable salt of silver and gold.

The next on the list of improvers is Mr. Tuck, who claims the exclusive use of certain ammoniacal salts;† and he, again, is followed hard upon by Mr. Woolrich, of Birmingham, who claims as a novelty the use of a magnetic machine for generating the electricity, and the use of certain salts which are to be found in Dr. Leeson's previous patent. These are the chief patents which have been taken out in connexion with this process: few of them are of any practical utility, and, for the most part, are of no further use than to add a few interesting facts to science. The cyanide solutions have been found to rank first in practical value; they are easily obtained, are inexpensive, are excellent conductors of electricity, and little liable to deterioration. The cyanides are the only solutions patented in France. The use of the magnet, in preference to a battery, for generating electricity, is a question merely of comparative expense. It is an established law in all depositions, that the decomposition of the salt is strictly proportional in amount to the quantity of electricity passing through the solution; and that apparatus, therefore, which gives most electricity with the least expense or trouble, is undoubtedly the best. The relative merits of the simple battery and magnetic machine are thus elucidated by Professor Daniel, in a work of his published during the present year:—"The amount of decomposition in this, as in all other cases, is in proportion to the quantity of electricity which circulates. By means of an electro-magnet and a constant battery, which was capable of decomposing by the primary current at the rate of eleven cubic inches of the mixed gases per minute, four cubic inches have been obtained by this secondary force." It would appear, then, that even when a battery is used in connexion with the magnetic machine, it requires three machines and three batteries to do the same work as one battery without the intervention of any machine. Without the aid of the battery, the largest magnetic machine hitherto made, and which was very costly, has only been found capable of decomposing three cubic inches per minute. Altogether, the magnetic apparatus appears to be a most preposterous application. It is costly and cumbrous—requires to be kept in constant rapid motion at a great expenditure of power—and, after all, does not increase the efficacy of the electricity one iota; but, on the contrary, much diminishes it. We are at a loss to conceive what may be the purpose of this expensive waste of electricity, except it is to astonish and captivate the ignorant by the display of an intricate machinery.

It may not be uninteresting to the general reader if we describe the process of electro-plating, and point out wherein it differs from the mode of plating hitherto employed. The articles to be electro-plated are first thoroughly cleansed from grease or oxide by means of caustic potash, and afterwards well brushed with sand: they are then dried, and carefully weighed; the weight of each article being noted in a book. A copper wire being attached to each piece, it is dipped as rapidly as possible into aquafortis, which removes every particle of oxide. It is then washed, and immediately immersed in the silver solution, in connexion with the negative pole of a galvanic battery—a plate of silver being in connexion with the positive pole. By this arrangement an equivalent of silver is dissolved from the plate, for that which is deposited from the solution upon the article. After remaining in the solution a sufficient time to obtain the required coating of silver, the articles are taken out, washed, and being dried, are carefully weighed; by which means, the weight of silver every article has acquired is accurately ascertained. The old method of manufacturing plated goods was as follows:—Square blocks (technically called skillets) of copper and silver being formed in the relative proportions desired, were hammered together, and being closely bound round with wire were placed in a furnace until they became united. After being again squared, they were placed between rollers, and rolled out to any required superfices. Any quantity of silver could be united to copper in this way; and the proportions have usually been made to vary from 2dwts. to 2oz. of silver to 1 lb. of copper—which 1 lb. of copper may be rolled out a yard square. The sheet of plated metal thus obtained formed the groundwork for articles of whatever form or however ornamented. This method of plating restricts the manufacture of plated articles to those kinds only which can be raised up from a plain surface. To raise this sheet of plated metal into form the hammer is used; the metal being frequently annealed, or raised to a high temperature during the operation, to prevent the silver coating from splitting. The hammering necessarily occasions a loss in the plating of the article; and this loss being upon the parts which leave the surface most extended by the operation, (that is, the more prominent parts,) considerably reduces the effective thickness of the silver. Again, where ornaments are required, recourse cannot be had to the usual modes of casting and chasing, because the metal must be plated *before* ornamenting; and the only mode of plating being by rolling, a more artificial method must be adopted to achieve the desired end. Iron dies being formed to the required models, thin silver leaf is stamped in them. The impressions thus obtained being filled with lead, are stuck upon the hammered form by means of soft solder. Forks and spoons, being *solid*, require a different treatment; and the method adopted is, to form the substance of these articles out of iron or other sordid metal, and solder a thin sheet of silver upon it. The main objection to this plan is, that the same temperature which melts the solder at first will melt it when the article is in use; and a much lower degree of heat will render it so soft that the silver may be easily cut through, the solder yielding to the pressure. The mode of manufacturing electro-plated ware differs from the old method in this essential point, that the articles do not require to be plated *before* but after making; so that there exists no restrictions in the modes of their manufacture such as obtain in the old process, and are so discouraging and vexatious to the artist. The body of electro-plated articles may be made exuberantly ornamental by casting and chasing, and may then be plated as easily as if quite plain. In fact, they may be worked in the same way as if made of solid silver; and being connected, where required, with hard silver solder, they are, in every point of strength and appearance, equal to solid silver articles.

The plating being effected by the deposition of the metal from a solution, necessarily attaches to every part to which the liquid has access, and is both singularly even, and may be made of any desired thickness. From the electric current striking first the more prominent parts, the parts most exposed to wear become more thickly coated than the rest, and the articles are, therefore, in a condition for more successfully resisting wear. Another great advantage of this process is, that any metal may be used for plating upon. A white metal, of the appearance and sound of silver, is used by the electroplater, whereas by the old method copper only could be used for most articles, alloyed metals not being sufficiently ductile.

It may not be uninteresting to notice a few of the objections which have been urged against electro-plating. As none of these objections attach to the new system exclusively, the necessity of such a notice is not very visible. We shall, however, spend a few words on the subject.

The first objection brought against the electro-plating process is, that in consequence of no solder having been used in the operation, there cannot be an adequate cohesion between the metals; and the plating, it is contended, must consequently peel off. This defect, however, it is found, is wholly imaginary, and the cohesion between the metals is found to be quite as powerful, when the operation is properly conducted, as can be attained by any other process. Cases have, no doubt, arisen where the electro-plating has peeled off; but this is indicative not of the badness of the new process, but of the neglect or unskilfulness of the operator. There is no process whatever that may not be made to fail; and in the process of plating in the ordinary way failures are sometimes met with: but such failures only show that the operation was performed by an unskilful person; and it would manifestly be preposterous to deduce from the unskilfulness of the person the badness of the plan.

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* The discovery or invention of the electrotype process is claimed both by Spencer and Jacobi, and it appears probable that both were independent inventors, though Spencer was undoubtedly the first—that is, he was the first person who obtained casts from objects by means of electric deposition. Messrs. Elkingtons' prior operations in electric deposition were restricted to the plating of metals.

† Ammoniacal salts we find to be very objectionable in practice.

Another objection which has been brought against electro-plating is, that the plating is soft because the deposited metal is pure. This objection would have weight provided the metal were *in the same state* in the two cases; for pure silver, for example, is certainly *ceteris paribus* softer than silver that has been debased by alloy. But the metal deposited by electricity is of a different atomic constitution from that which has only gone through the furnace: it is denser, harder, and more compact; and the greater softness due to its purity is neutralized by the greater hardness due to the increased proximity of its atoms.

Such, then, is an outline of this very refined and important invention. Like all new inventions of merit, it must meet, and, we suppose, has met already with a strenuous opposition; for an invention of value must always make the ancient practitioners tremble. But nothing can arrest the progress of real improvement; and the noisy anger of its opponents must only force it into a higher position, by making it more known, and, consequently, more regarded. To us it is obvious that this mode of plating must speedily supersede all others, and will produce a most abundant harvest of wealth to those who have brought the invention to its present maturity. This result would probably be attained, even if the invention had no other applications than silvering and gilding; but these, though important applications, sink into insignificance when contrasted with the important benefits to be achieved by the extension of the process to coarser and more serious purposes. Thus the zincking of iron alone, by this process, will, we are confident, at no distant time, become an employment of great emolument and importance. Boilers, for example, will be made of zincked plates—iron ships will be zincked—and, indeed, all iron works liable to corrosion. For such purposes as coating the holding-down bolts of marine engines, the process is of much value; and we are by no means sure that iron bolts coated with zinc or copper will not hereafter be used for fastening ships. They might be made screw-bolts if there is any difficulty in the clenching. For many of the purposes of engine-work the procss is highly applicable. Thus bilge and feed-pumps might be zincked or coppered in the inside, which would add greatly to their durability; and even the insides of condensers might be zincked with great advantage. The applications of this new process, in short, are infinite; and those, we believe, who know it best, will estimate its importance most highly.

Art. VII.—STEAM-ENGINE PISTONS.

Part 1st. BEING PRINCIPALLY THOSE OF LOCOMOTIVE AND LAND ENGINES.

We believe the variety that appears in the annexed collection of pictures will at first strike the eye. Had it been our object to present as extensive a catalogue as possible, we should have added to their number; or had we intended to make merely a selection of the most approved, we might greatly have retrenched it. By presenting a somewhat heterogeneous and unselected enumeration of the principal varieties, just as they have occurred to us in practice, and noting their respective characteristics, whether merits or defects, we, perhaps, make our paper more instructive than if we were to give either a more methodical description or more restricted catalogue.

A consideration of the annexed sketches leads us to rank metallic packed pistons into two divisions, (which, if not perfectly distinct, are sufficiently so for the purposes of classification,) to one or other of which each may be referred: those in which the expansive force of the rings alone is used, and those in which it is either assisted or entirely superseded by springs. The former kind, by far the simplest and most obvious, seems to be of much the more recent adoption; and just adds one to the many instances which the history of engineering presents, of the shortest road being the last to be taken. Of this species we may reckon three varieties; first, those in which hemp packing requires to be compressed into the space between the rings and the piston, to aid the elasticity of the former; this is commonly the case in pumping engines, where hitherto the more complicated and expensive descriptions of packing have not been generally adopted: and such we are informed is that used in the Cornish engine, in the East London Water Works.

Fig. 10 represents a piston of this variety, at work in a pumping-engine in Perthshire, manufactured by the Messrs. Maxton, of Leith; the oblique cut in the ring being designed to prevent the sharp edges of the break from grooving the cylinder. In this description, two rings are generally employed, one above the other, with the breaks about 90° apart, to prevent the steam escaping at the joint. This is the simplest kind of metallic packing, but even in this elementary form, when properly fitted up, it possesses nearly all the advantages of the more complicated descriptions; and, we hesitate not to say, approaches much more closely in excellence to the best possible form of metallic packing, than the most improved hemp packed piston does, and if earlier adopted would probably have gone far to prevent the introduction of the more costly constructions now in such general use.

The disadvantage of this plan lies in the necessity of occasional adjustment, when the internal hemp gasket loses its elasticity, the frequency of which depends upon the accuracy with which the end joinings of the external rings are contrived to prevent the inlet of steam into the hemp, and also in some degree upon the temperature and pressure of the steam itself.

Closely allied to the above, is what we may term the second variety of this species, an external packing ring like the former, but deriving its lightness from its own elasticity, and, of course, not dependent on the hempen packing behind. The simplest and perhaps the most common method of giving the requisite spring, is to turn the packing rings a little larger than the diameter of the cylinder, and when sawn through to cut a tenor and mortice, or a half check in the abutting ends, and then to compress the ring by an iron hoop with screws, and to fix it temporarily with a pin put through the overlapping or morticed ends; in this state the rings are ground on the surface joints, and the piston made ready for its place; when, the hoop being unscrewed and the temporary pin withdrawn, the rings are suffered to expand in the cylinder by their own elasticity, which will generally continue to act till the rings and the cylinder are so much worn as to permit the former to expand to its natural extent.

Sometimes the abutting ends are left plain, in which case a piece is merely cut off one end, to allow the ring to be compressed to a lesser diameter. Great diversity of opinion exists as to the merit of this species of packing; that it is a decided improvement upon the former is unquestionable, but it is alleged, that in accuracy of form, and facility of application to the cylinder, it is greatly inferior to the ordinary more complex varieties, with a number of segments and artificial springs to each. It is said, in the first place, that it tends to wear the cylinder off the truth, and no small degree of ingenuity has been put in requisition to remedy the evil; with what degree of success we shall consider just now. Appeal to experience might seem the shortest way of settling the question, as many pistons both of the simple and the amended construction are in use, but in this as in many other cases, recorded experience only serves to prevent any conclusion whatever, or rather tends equally to two contradictory results.

Let us, then, investigate the action of the simplest form. The ring, when first compressed, does not naturally assume the circular form, as by the two ends being brought together the tendency to expand to its original dimensions is mainly checked in only one direction. When confined in the cylinder, however, it will be seen at once that it is compressed equally in all directions, and must therefore exert a corresponding force equally in every direction, to recover its original dimensions. This appears so plain, as scarcely to be susceptible of illustration. Suppose, for instance, the original diameter of the ring to be 18¾in., and to be compressed into an 18in. cylinder, it will at once be seen that every diameter of the ring being compressed equally has an equal tendency, and must exert an equal force, to regain its original dimensions.

Instead of an exterior compressing cylinder to confine the ring, we may, to assist the true conception of the case, suppose the various diameters to be replaced by so many bowstrings, each of which plainly exerts an equal strain in confining its respective semicircumference, and thus the amount of pressure exerted around the entire circumference must every where be equal. We are told that this has been denied, and the reverse maintained by some judicious practical men, but chiefly, we believe, if not entirely, on theoretical grounds; and even though recorded experience be appealed to in support of their views, it cannot neutralize the opposing testimony, that in some cases the cylinder has been found to have worn perfectly true.

The variety and ingenuity, and we might add, complexity of the various contrivances adopted, to correct this supposed defect in this description of packing, and the alleged success by which they have been attended, must be our apology for dwelling on the subject. But although the apprehended evil did exist in its full amount, and the rings really had a greater tendency to expand in the direction perpendicular to the diameter, passing through the break, we do not see what bad effect would ensue; the cylinder would be worn almost imperceptibly oval, till at length the inequality of pressure in the ring would be exactly counterbalanced by corresponding ellipticity in the cylinder; and not only so, but the next rings that happened to be put in would fit with as great truth as the most hair-breadth system of compensation could possibly effect, since the alleged unequal expansion of the ring would then correspond exactly with the shape to which the cylinder has by that time worn.

It is abundantly obvious, however, that the effect upon the cylinder of the unequal expansion might be altogether neutralized, (were it ascertained to have any proper existence,) by using two rings instead of one, the position of the joints being 90° apart. It is not uncommon to have the rings placed with the joints on opposite sides of the cylinder, or 180° apart: an arrangement only useful to prevent the passage of the steam through the single break, (an object which might be easier attained in another way,) and incapable of exerting a correcting influence on the above named inequality.

Under the third modification of this description of packing, we class those in which each ring is still in one piece, but in which some of the above modes of compensation are had recourse to. The common method is, simply to turn the ring about one-third thinner toward the part where the joining is made; two rings are commonly used, the position of the joints being as above described, and instead of the rings being turned of greater than the required diameter and then sprung in, the requisite elasticity is given by hammering the thicker semicircumference on the hollow side. Of course, the same method may be taken with rings of uniform thickness, and to derive the full effect of the hammering, it might be well to retain the original skin of the casting on the inside of the ring. The advantage of giving the requisite elasticity by hammering rather than by compressing the ring, lies in the more perfect circularity ensured by the former; but were the precaution taken to turn up the compressed rings in the lathe, before being put into their place, this difference would no longer have place.

This arrangement has been generally found to work very well; but, perhaps, not better than the preceding more simple variety, when the workmanship of both is equally correct; and to deficiency in this particular, we apprehend, must be ascribed any disadvantage which the latter, as sometimes, constructed, have been found to labour under. A variety of methods have been taken to prevent the escape of the steam by the open end joints which this species of ring exposes; frequently hemp packing is put behind the rings, as shown in fig. 10 and 13; sometimes they are merely cut as in fig. 13, without any further provision; and sometimes, as in fig. 9, the evil is left in its full magnitude, without any attempt at a remedy; but by far the best plan, undoubtedly, is to rivet a piece of brass, previously fitted to the proper curvature, to the inside of the ring on one side of the break, so that it shall apply correctly to the other side, and slide along steam tight as the ring expands by wearing. Inattention to this simple precaution has been the occasion of great inconvenience, and has even led to the substitution of a much more expensive, though not in reality much more efficient system.

Deferring our remarks on some important modifications of this construction till we come to consider the plates in detail, we proceed to consider the second principal division of our subject, comprising many subvarieties: we mean, that class of pistons where artificial springs are used, acting in most cases by the intervention of blocks or wedges. The most common construction is as follows:—two strong cast iron rings of such dimensions as to have no perceptible elasticity themselves (say from 13¼in. to 2½in. square in the cross-section) are cut, each into from three to six or eight segments, according to the size of cylinder, or other regulating circumstance, placed the one above the other, so as to break bond at each joint, and at each break part of the ring is cut away to admit the introduction of a wedge usually of the angle of 90°, the point of which may be ¾in. from the surface of cylinder: a common elliptical spring is then introduced between the body of the piston and the back of the wedge. Sometimes, instead of a wedge, a simple block is used, or the spring presses immediately upon the back of the ring. Fig. 6, which we shall afterwards have occasion to refer to, represents one of the most approved pistons of this variety.

In the original form of this piston, as constructed by Barton, the points of the wedge came in contact with the cylinder, being situated in the periphery of the piston, and in order to prevent their injurious action in grooving the cylinder, it was proposed to make them of softer metal; and, we believe, it is to Tredgold that we are indebted for the suggestion of the above-described greatly improved modification. In this description of piston, the mode of action of the wedges is what seems principally to require investigation. When the points of the wedges are not in contact with the cylinder, the mode of action is sufficiently obvious; the intervention of the wedge serving simply to multiply the energy of the springs on the principle of the wedge, as a simple mechanical power. Of course, the more acute the angle of the wedge, the greater force is imparted to the springs, on the principle of virtual velocities; and were the segments only required to expand indefinitely, instead of expanding and contracting by turns, to suit the inequalities in the cylinder, then a very acute wedge might be used; but as the wedge must be ready to spring back, to allow the packing to yield when it comes to a tight part of the cylinder, as at the top and bottom of the stroke, it is plain that the inclination must be considerably greater than the angle of repose; it is seldom, however, made less than 80° or 90°, but we believe a considerably sharper angle would be found to answer. Considering now, for a moment, the case when the points of the wedges come in contact with the cylinder, it might seem, at first sight, that they would exert no pressure at all upon the adjacent segments; and such would be the case, were it possible for them to wear no faster than the rings themselves; a little consideration, however, will show that this can never be the case, as the wear upon the wedge must be to that of the ring, in the proportion of the side to half the base of the wedge; that is, in the case of a right-angled wedge, as the diagonal to one of the sides of a square: were the wedge and the cylinder then to be made of the same material, the wear of the cylinder opposite the wedge would exceed that of the rest of its surface, in the above proportion, or probably in a somewhat higher ratio, arising from the different grain of the metal composing the wedge. These, however, are almost always made of gun metal, which serves in a great measure to neutralize what would be otherwise the injurious tendency of this arrangement.

The locomotive piston, fig. 4, which we shall have occasion to revert to again, is sometimes constructed as above, with the points of the wedges at the circumference; and in spite of every precaution, the effects of the unequal pressure are slightly perceptible, in the faint grooves which may at times be detected in the cylinder. In fact, we must be allowed to express our surprise, that the eminent engineers, who bear sway in the *Clarence*, could be induced to adopt an arrangement, which by almost unanimous consent has been long since abandoned as antiquated, and would probably in the hands of less practised mechanics turn out a complete failure.

Having premised these preliminary remarks, we now proceed to consider, in detail, several of the varieties that have come most prominently under our notice, the better able to decide upon their respective merits from the general principles we have laid down.

Fig. 1 represents two views of the locomotive piston made by Messrs. Forester and Co., Liverpool, for the Grand Junction Railway. The peculiarity of construction and mode of action is apparent from inspecting the drawing. By fitting a tongue piece, or tenon, into a corresponding mortice, in both wedge and ring, it is intended to prevent the passage of steam at the breaks of the segment, instead of the common method of using two rings, each of half the thickness, with the joinings of the one ring placed midway between those of the other. We believe this construction has been found to answer perfectly; but this is not paying it a distinguishing compliment, as we shall soon see that the same may be said of certain other descriptions, about which there is not above one-fourth of the workmanship here displayed. In fact, display is the very idea which this piston suggests; the elegance of the design, the slenderness of the working parts, and the extreme accuracy of workmanship, necessary to its action—and which the Messrs. Forester are never known to spare—rather serve to point it out as a pretty engineering toy (not without its share of usefulness, at the same time) than as a plan likely to be either extensively adopted, or generally approved of. In the first place, there can be no doubt, that the prevention of leakage by the joints would be at least as effectually accomplished by having two rings arranged as above described; a method that will generally be found, in the hands of common workmen, to be of much easier execution; very great nicety being required in the fitting of the sliding pieces into the mortices, and the slightest imperfection at first having a tendency to wear worse from the constant passage of the steam. Again, as the sliding pieces must move forward faster than the segments (when the wear commences) in the proportion of the diagonal to the side of a square, as can easily be demonstrated, it follows, that the pieces themselves, and consequently the part of the cylinder corresponding, must wear faster too; and thus is the cylinder liable to be worn unequally. The extreme slenderness of the springs, and the slight pressure which they are generally required to exert, may, indeed, for the most part, prevent this inequality from being readily perceptible; but it is evident that the action is in some measure similar to that of a flat pointed wedge pressed forward by a spring, and itself in contact with the cylinder.

We shall farther find, on comparing this piston with more simple varieties, that it is unnecessary to divide the ring into so many segments. Such a complete system of adjustment and compensation might have been very beneficially employed during the pupilage of steam cylinders, when the ordinary boring machine was a little urchin, with a handful of rough sandstone, or did the boring bar, in imitation of "Inman's Method," describe a series of parabolic curves; but is sufficiently proved to be altogether superfluous in the present state of machinery, by the fact, that a ring cut in a single place is found to give perfect satisfaction.

Fig. 2 represents plan and section of a piston manufactured for common and locomotive engines, by Messrs. Dircks and Nelson, late of the Etna Foundry, Liverpool, differing from the above, in having only one wedge and break in the ring instead of four. The set screw, on the side farthest from the wedge, might be omitted; the two side screws serve in some measure to compensate for the sluggish action of the right angled wedge, which seems rather to press the ring against the cylinder at the point immediately adjacent, than to force it open, and thus make it bear equally all round. A more acute wedge would propagate the pressure of the spring more readily throughout the entire circumference. A circular spring, like that used here, while it posseses several conveniences, is yet less delicate and perfect in its action than the common elliptical kind; and, perhaps too, less easily reset or retempered.

Very similar to the first variety is that shown in fig. 3. We doubt whether the slight superiority in point of simplicity gained by doing away with the adjusting screws, and substituting a single spring hoop, be not more than counterbalanced by less perfect action. A method intermediate between the two last is sometimes adopted; the packing ring is cut, and a sliding piece and wedge employed in two opposite places, and a circular spring, with set screws, acts upon each.

Fig. 4 represents a plan of the piston so extensively known as Edward Bury's locomotive piston. The distinctive feature in it is, that each spring acts upon one wedge in the upper ring, and another in the lower, the centre of the spring, contrary to common usage, being made the "point d'appui," from the body of the piston. This variety is free from some of the defects of Forester's, and when managed with care is found to work with great truth and accuracy. First cost of workmanship, unnecessary complication, considerable liability to derangement, are accompanying qualities which will be found to act more or less, as drawbacks in different circumstances, and which by some may rather be deemed matters of financial than of engineering science. Among the great variety used on the Gloucester and Birmingham Railway, this description has been found to give the greatest satisfaction, while on some of the other lines they are in the course of being superseded by simple forms, which are said to be every way preferable. The uncouth contour of the springs involving, as it does, the difficulty of replacing them elsewhere than they were first manufactured, is a point almost too insignificant to be noticed, but which, we doubt not, has tended to bring them into disrepute on some of the lines of railway above alluded to.

Fig. 5 represents a kind of piston used on the Liverpool and Manchester Railway, very similar to fig. 2, or to those used on the Grand Junction Railway. As before remarked, the obtuseness of the wedge seems to be almost the only defect in this simple and elegant species of packing. We must, however, confess that, in urging this particular we form our opinion on theoretical, we had almost said, conjectural grounds, as we have never met with a more acute angle in a piston, than from 80° to 90°. The pistons on the Liverpool and Manchester Railway are generally brass. This is an advantage in horizontal or inclined cylinders, as the softness of the material, and the greater lightness of the piston, considerably reduce the wear of the cylinder. Brass pistons are, on this account, much used for locomotive engines; one drawback, however, to their employment, is, the inferior elasticity of the metal, which renders the employment of artificial springs necessary.

Fig. 6 represents plan and section of piston both for marine and land, manufactured by the Messrs. Maxton, of Leith. This may be regarded as a favourable, and at the same time, characteristic specimen of the most generally approved and widely adopted variety of packing in which separate springs are employed. The ease with which the springs may be bent and reset to the proper compass prevents set screws from being required; the only seriously objectionable point seems to be the expense of fitting and grinding steam-tight the ten wedges required. But if there be multiplicity of parts, there is simplicity of action, and but little liability to derangement; and, perhaps, the great durability and perfect action of the working parts fully counterbalance all the extra expense of workmanship which this species may require. While, however, we may admire the capability of perfect adaptation to the form of the cylinder, which this piston presents, we must express our decided opinion, that a sufficient, if not, practically speaking, an equal degree of correspondence might be attained at a fraction of the expense; this, however, supposes the case of a new and perfect cylinder; but where that has been previously worn unequally by hempen packing, as is frequently the case, then this modification possesess decided advantages, and has, we believe, been repeatedly applied by the Messrs. Maxton in these circumstances, with great success. The use of wrought iron nuts, fitted into the body of the piston to receive the junk ring screws, instead of tapping them into the cast iron, is a very obvious, though not very common improvement.

Figs. 7 and 8 represent views of piston and packing rings, as constructed by the Dundee Foundry Company—(James Stirling, the well-known improver of the air engine, manager.) The peculiarity of this piston consists in the eccentric groove, about half the depth of the packing ring, being turned out in the interior circumference of each, accompanied by numerous saw draughts, in the remaining upper and lower projections; the effect of which, in modifying the elasticity of the ring, is just what would be produced by turning off the projections altogether, and making the groove, or recess, the entire depth of the ring; the advantage gained by the plan adopted being the greater breadth of bearing and of steam-tight surface thereby obtained. This may have been *intended* for a very ingenious contrivance—we wish we were able to say more in its behalf.

Let us compare this piston, for an instant, with figs. 14, 14′, being the packing rings employed in the locomotives on the Glasgow and Ayr Railway. The experienced superintendent of the engine works on that line, so far from taxing ingenuity how the most mechanically and scientifically to weaken the rings, in the part farthest from the break, has deemed it necessary to strengthen them considerably along that portion of the circumference, by boring them eccentric from a centre whose position is diametrically the reverse of that assumed in the Dundee Foundry pistons; the perfect success of which manipulation, while it does not demonstrate the inefficiency of the more simple concentric form of ring, serves unquestionably to condemn the laborious ingenuity that has been put in requisition to procure a deviation from that form in the opposite direction. Let us compare, again, the peculiarities of this latter variety with that employed in the famous Gorgon engines. The eminent engineer, whose name is associated with this notorious variety, judging, like the superintendent of the Glasgow and Ayr Railway, that the rings required to be strengthened rather than weakened, at the part where it is generally thought the greatest strain is exerted, has turned the exterior and interior circumferences from different centres; but has somewhat differed from Mr. Robertson as to the amount of eccentricity required; for, while the latter has found that a difference of one-third, or one-fourth, between the thick and thin side, is sufficient, Mr. Seaward has deemed it advisable to make the one just four times the thickness of the other.

Comparing, then, the Dundee foundry pistons with the Gorgon variety, and recollecting the established, or at least admitted fact, that the stiffness, or resistance to flexure of a body, is inversely as the cube of the dimension in the direction of which the strain is applied, we have the former variety rendered eight-fold more flexible, compared with a ring of uniform thickness and the same dimensions at first, while the latter is just made 64 times less flexible; and both plans, it seems, are taken with the best intention in the world, to remedy the self-same defect; we doubt not we should be unhesitatingly told, that practice, that infallible and impartial arbiter, had given a decided verdict in favour of both.

It has been said that there are more false facts than false theories in the world: one reason of this is obvious—it takes many facts to confirm one theory; and when a false theory is to be constructed, both interest and necessity compel the architect to go in search of false facts to support it. These observations we throw out, to guard against the common error, that whatever distrust may be due to established theories, there is no precaution necessary in receiving recorded facts.

If the fact that philosophers have differed, in the proportion of 1 to 64, in their estimate of the comparative efficacy of the overshot and undershot water wheel, should make us somewhat distrustful of theoretical computations; then, surely, the consideration that practical men have differed, in the ratio of 1 : 512, in determining the strength of metallic packing rings, should make us at least as cautious in admitting their testimony.

If, however, the difference of size in the cylinder of the Gorgon engine, and that belonging to the Dundee Foundry, should be held as invalidating the above startling conclusions, the diameter of the former being four times that of the latter, (from which the sketch is taken,) we may compare the piston of the Gorgon with that of the "Toward Castle" steamer, the packing of the latter consisting of two cast iron rings, each of one inch in thickness originally, and made equal throughout, but reduced afterwards in three or four different places, with the view of making it apply more accurately to the interior of the cylinder. This packing derives its entire elasticity from being compressed into a smaller circle than that to which it was originally turned; and greatly weakened as it is, both by the manipulation above described, and by a long period of subsequent wear, it still continues in good working order, after being in pretty constant use for the space of ten years. The packing rings of the Gorgon, on the other hand, each in one piece, are made three inches in thickness, on the side farthest from the break, and but three-quarters of an inch on the thin side, where the ring is cut, being, in fact, nearly crescent shaped; with the view, doubtless, of opposing the greatest practicable resistance to the greatest strain. It might easily be shown that, while, by such an extraordinary shape, the suppleness or capacity of flexure, the quality most valuable in a packing ring—in fact, the very quality on which depends its use as a steam-tight packing at all,—while this quality is indefinitely diminished, with the view of obtaining the requisite strength, this very property is itself materially injured at the same time; and we are presented with a mechanism at once almost unsusceptible of adjustment on account of its strength, and unable to resist a strain on account of its stiffness.

Art. VIII.—THE FRENCH PROTESTANT CHURCH.

The first French Protestant church was founded by Edward the Sixth, and its members consisted of Lutherans and other schismatics, who were driven from France by the persecution then raging. The present church is a new and very elegant building, constructed from the designs of Mr. Higgins. The structure is of no great pretensions either in point of size or richness of embellishment; but there is a grace and elegance about it which at once recommends it to every spectator, and reveals the hand of a master. Insignificant in many respects as this building is, it gives evidence of capacity such as few of the edifices recently erected in London have succeeded in making manifest; and we can hardly doubt that the taste and skill which betray themselves in so trivial a construction would shine out with a far higher lustre on a more important occasion.

The late French Protestant church was situated in Threadneedle-street: its site is now occupied by the Hall of Commerce. The dimensions of the present building we are unable to give: our applications to Mr. Higgins to be furnished with them have been disregarded—we suppose in the idea that an *Artizan* must be a very contemptible animalcula. The quality of the building may, however, be judged of from the Photographic view, for the accuracy of which the sun himself is responsible.

Art. IX.—GLYPHOGRAPHY.

Glyphography is a new method of engraving, in which the refined agency of the electrotype process is made instrumental to the production of the desired effect. The principle of the invention consists in depositing, in the grooves or scratches made on a sheet of some soft substance, a stratum of copper, which, of course, thus becomes an exact counterpart of those scratches; and the impression thus produced is used for printing from, in the same manner as a type or woodcut. Glyphography, therefore, is just a mode of stereotyping by the aid of electricity, with this important difference, however, that the stereotype is derived not from another block or type, but from the drawing made by the artist. The drawing must be made in a particular way, which is thus described by Mr. Palmer, the inventor of the process:—

> " A piece of ordinary copper plate, such as is used for engraving, is stained *black* on one side, over which is spread a very thin layer of *white* opaque composition, resembling white wax, both in its nature and appearance: this done, the plate is ready for use.
>
> " In order to draw properly on these plates, various sorts of points are used (according to the directions here given), which remove, wherever they are passed, a portion of the white composition, whereby the blackened surface of the plate is exposed, forming a striking contrast with the surrounding white ground, so that the artist sees his effect at once.
>
> " The drawing, being thus completed, is put into the hands of one who inspects it very carefully and minutely, to see that no part of the work has been damaged or filled in with dirt or dust; from thence it passes into a third person's hands, by whom it is brought in contact with a substance having a chemical attraction or affinity for the remaining portions of the composition thereon, whereby they are heighted *ad libitum*. Thus, by a careful manipulation, the *lights* of the drawing become thickened all over the plate equally, and the main difficulty is at once overcome: a little more, however, remains to be done. The depth of these non-printing parts of the block must be in some degree proportionate to their width; consequently, the larger breadths of *lights* require to be thickened on the plate to a much greater extent, in order to produce this depth. This part of the process is purely mechanical, and easily accomplished.

Cook and Co., Printers, 76, Fleet Street.

Cook and Co., Printers, 76, Fleet Street.

> "It is indispensably necessary that the printing surfaces of a block prepared for the press should project in such relief from the block itself as shall prevent the probability of the inking-roller touching the interstices of the same whilst passing over them; this is accomplished in wood engraving by cutting out these intervening parts, which form the lights of the print, to a sufficient depth; but in Glyphography the depth of these parts is formed by the remaining portions of the white composition on the plate, analogous to the thickness or height of which must be the depth on the block, seeing that the latter is in fact (to simplify the matter) a *cast*, or *reverse*, of the former. But if this composition were spread on the plate as thickly as required for this purpose, it would be impossible for the artist to put either close, fine, or free work thereon; consequently the thinnest possible coating is put on the plate previously to the drawing being made, and the required thickness obtained ultimately as described.
>
> "The plate thus prepared is again carefully inspected through a powerful lens, and closely scrutinized, to see that it is ready for the next stage of the process, which is, to place it in a trough, and submit it to the action of a galvanic battery, by means of which copper is deposited into the indentations thereof, and, continuing to fill them up, it gradually spreads itself all over the surface of the composition until a sufficiently thick plate of copper is obtained, which, on being separated, will be found to be a perfect cast of the drawing which formed the *clichée*.
>
> "Lastly, the metallic plate thus produced is soldered to another piece of metal to strengthen it, and then mounted on a piece of wood to bring it to the height of the printer's type. This completes the process, and the glyphographic block is now ready for the press.
>
> "It should, however, have been stated previously, that if any parts of the block require to be *lowered*, it is done with the greatest facility in the process of mounting."

It will be at once manifest that this mode of producing impressions in relief is susceptible of numerous effects which cannot be produced in wood-cutting without infinite labour. The intersection of lines, for example, or cross-hatching, as we believe it is technically called, can scarcely be accomplished in wood-cutting at all; whereas, by this new process, it is accomplished with as much ease as any other. In short, this method is susceptible of all the variety and all the delicacy of line-engraving; and, with these advantages, combines the great recommendation of being susceptible of being printed with type in the same way as wood blocks. We do not imagine that the plan has yet reached that degree of perfection which deprives it of all practical objection; but, in its present state, it appears capable of producing pictures far transcending in excellence any other of the modes of representing objects by engraving in relief. The annexed figures, however, may be taken as a safer indication of its quality than any statement we might make on that head.

It has been objected to this mode of engraving, that it cannot be printed at a steam-press. This objection we know to be unfounded, as we have now before us a number of glyphographic engravings printed at a steam press, and in which the impression is very well brought out. These engravings any one may see on application at our office.

We do not, however, pretend that glyphographic impressions are not of inferior quality if printed at a steam press, than if printed by hand with greater leisure and care; but the self-same rule holds with impressions of every kind, especially if they are fine and delicate. The best kind of wood-engravings cannot be done justice to in a steam press; and glyphographic cuts possess no advantage over wood in this particular. They are, however, in one respect better adapted than woodcuts for the steam press, inasmuch as copper being a stronger material than wood, is better able to withstand the pressure and violence to which in a steam press it will probably be subjected.

ART. X.—COCKERELL'S LECTURES ON ARCHITECTURE.

We intended this month to have given an analysis of the lectures on architecture lately delivered by Professor Cockerell before the Royal Academy; but we find it impossible in our present Number to spare the necessary room. There is much in those lectures to admire and applaud, but we fear there are also some distorted views and false philosophy; and we esteem it a work of much importance to distinguish the one from the other, so that the student may not be imposed on by the authority of a name. This analysis we shall probably attempt in our next Number.

ART. XI.—MAUDSLAY AND FIELD'S PATENT ENGINES.

The high reputation Messrs. Maudslay and Field enjoy as engineers naturally excites the expectation that any invention or improvement brought forward by them will be of no mediocre quality. The rage for direct-action engines which has latterly prevailed, has brought them into the field as inventors; and high hopes were raised that some contrivance of unusual merit and ingenuity would be the consequence. But these hopes have been utterly unfulfilled, and the direct-action engines of Messrs. Maudslay and Field are the worst planned, and the most indicative of penury of invention of any that have come under our notice. They, no doubt, are able to work, and have, we believe, been brought into considerably extended use; but any success which may have attended their operation is due almost exclusively to excellence of workmanship, not to eligibility of plan; and their extensive introduction is simply and solely the effect of Messrs. Maudslay's reputation and influence. With the same quality of workmanship which common engines very often obtain, we do not hesitate to say that some kinds of these engines would have proved a disastrous failure; and we are equally confident that had the various plans of direct action brought forward by Messrs. Maudslay been the product of any engineer of a less imposing name, they would have been received with laughter and derision. In some parts of their patent engines, it is true, expedients are introduced of excellence and merit: the details of the cylindrical slide-valves, for example, and several of the details of the air-pump, exhibit considerable judgment and ingenuity; but in the main features of their direct-action plans there is not an idea manifested except what must have suggested itself, and been discarded by every tyro. In short, we look upon the plans of these patent engines, as they are called, as among the most remarkable monuments of the present day of retrograde improvement and coarse and clumsy invention.

It is time, however, that we should explain the structure of these engines to those of our readers who may happen to be unacquainted with their peculiarities. There are two varieties of engines for which Messrs. Maudslay have patents. The first of these, which is the invention of Mr. Field, and is by much the least bad, consists in the application of two cylinders to each engine, the cylinders being situated so far apart that the connecting rod may vibrate between them. The two pistons rise and fall simultaneously, the piston-rods being connected at the top to a cross-head, from which a long tail descends to the space between the cylinders, and is guided there by grooves. From the bottom of this tail the connecting-rod springs: the cross-head and its descending tail are of a T figure, and are composed of iron plates, with a space between the cheeks, in which the connecting-rod works.

We are at a loss to imagine what advantage this plan can have over the plan of a single cylinder with double side rods first contrived by Mr. Napier, of Millwall, and applied by him twenty years ago in the "United Kingdom" and other vessels. There is a vast deal more work upon this new plan, and the weight of the cylinders and friction of the pistons must also be greater. Then again, the new plan takes up considerably more room, an area of cylinder in two circles being necessarily of greater length than the same area in one; in addition to which the cylinders require to be placed sufficiently far apart to admit of the angling of the connecting-rod between them. The cylinders, be it remarked, require to be placed one before the other in the vessel, so that it is in the length of the vessel, which is, of course, the most valuable dimension, that the greater extension obtains. Finally, the external surface of two cylinders is greater than that of one, and the loss of heat by radiation is greater in the same proportion. In consequence too of the necessity of using one valve for the two cylinders, the ports are inevitably long, and a greater loss of steam is thus occasioned than in engines on the common plan.

But whatever be the faults of the Siamese engine, they are trivial, in comparison with those of the annular engine of Mr. Joseph Maudslay. This engine is so bad a one, that we really feel it to be beneath our criticism, and we rather suspect Messrs. Maudslay are themselves sensible of its defects, as we find that very few of them have been constructed. In the annular engine one cylinder is placed within the other, and in the internal cylinder the connecting-rod works. The piston is, consequently, of the shape of a ring, with packings pressing against the inside of the outer cylinder, and the outside of the inner. The amount and difficulty of the workmanship upon this kind of engine exceed belief: the piston, it is extremely difficult to make or keep tight, and the bottom of the connecting-rod; and numerous other parts of the engines are almost inaccessible.

Such, then, are a few of the particulars of Messrs. Maudslay and Field's patent engines; and from what we have said, those of our readers will have no difficulty in forming an opinion of their merits, who refuse to be imposed on by the glitter of a name. Our own opinion is, that while the workmanship is admirable, there is no other plan of direct action-engines, of any reputation, so utterly puerile and ridiculous; and we are very confident that all who understand such subjects, and are content to consider them without prejudice or prepossession, cannot fail to arrive at the same conclusion.

ART. XII.—MILLINGTON ON ENGINEERING.

Elements of Civil Engineering. By JOHN MILLINGTON, Civil Engineer. Philadelphia: J. Dobson. London: Wiley and Putnam; and John Weale. 1843.

We agree with Mr. Millington in the following observations, which we find in the preface to the work now before us:—

> "The subject of Civil Engineering is one upon which much has been written by some of the first scientific characters of the world; but their writings are so diffuse, so various, and so detached, on account of their investigations having been directed to particular objects, that there is, perhaps, no branch of science in which the student or young beginner finds so much difficulty in obtaining the knowledge necessary to qualify him for his business as in Civil Engineering. Among the almost numberless works which the presses of Great Britain and France issue annually, it is surprising that no attempt has yet been made (to the knowledge of the writer) at any thing like a compendium of the science of Engineering. The English nation is even avowedly poor in practical works of this description; for, until the formation of the Society of Civil Engineers of London, and the more recent establishment of the Institution of Civil Engineers, the persons who followed the profession appeared to harbour a jealous suspicion of their modes of operating and proceeding meeting the public eye; and, with the exception of Smeaton's account

> of the building of the Eddystone Light-house, and that of the building of Essex-bridge in Dublin, there was scarcely a work of any importance to be found in the English language."——" The French, on the contrary, have been much more liberal in their publications; but their works are confined either to scientific investigations, or to the account of particular objects diffused through many large and expensive volumes, so that a student in Civil Engineering had no chance of knowing what had been done on the continent of Europe without access to a large public library; and even if he possessed that advantage, it was perhaps useless to him, from not understanding the language the works were written in, or, more especially, from his possessing no key or directory where he should search for particular information."

Although Mr. Millington, in these observations, justly represents the hiatus that exists in the literature of Engineering as sufficiently large to afford ample scope for the display of the most varied talents of all who may be ambitious of filling it up (and he is himself one of the number), we must not proceed to the examination of his book without stating that he approaches a task so gigantic with a proper sense of the difficulty of adequately accomplishing it, and makes no pretensions to have completely supplied the deficiency. His work is, indeed, he tells us, mainly composed of the substance of his course of lectures on Civil Engineering in William and Mary College, Va. This much being premised, therefore, as to the humility of Mr. Millington's pretensions, we proceed to give our readers some idea of the nature of his work.

The first five chapters are devoted to the subjects of architectural and mechanical drawing and drawing instruments, mensuration, levelling, and surveying, with an account of the principal instruments used in these operations. Then follow two chapters on earth-work and the construction of roads. The eighth chapter treats of building-materials, including stones, bricks, and mortars or cements, timber, iron, and other metals. Chapter IX. contains a digest of the principal propositions that have been ascertained as to the strength of materials, the direction and amount of strains in different frame-works, &c. Chapter X. describes the building processes under the three heads of stone-work, brick-work, and carpentry. The last, including the principles of roofs and centring for stone bridges, as well as the most common plans that have been adopted in constructing timber bridges. Chapter XI. treats of arches and foundations, and the book is closed by a chapter on the application of the principles previously discussed to some of the most usual works the engineer is called on to undertake, such as railroads, canals, and the improvement of navigable rivers. When we add that all these subjects are discussed in the space of about 700 octavo pages, it will be at once seen that they must be treated in a very general, if not in a very superficial, manner. Accordingly, on a perusal of the volume, we find that the general principles are laid down in a popular and very intelligible manner, many of the most usual forms of construction and methods of proceeding are given; and, on the whole, a very just idea is afforded to the tyro, or general reader, of what engineering really is. To the amateur or general reader we can confidently recommend this work as the best we have met with for the purpose of imparting such a knowledge of the objects and operations of engineering, as will form no mean part of that stock of general knowledge which is one of the main advantages derivable from a liberal education. To those youths who entertain thoughts of studying engineering as their profession, we would also recommend this work as one of the best from which they could obtain a correct insight into the nature and extent of their future avocations, should they become professional engineers, and thereby be enabled the more readily to judge whether these avocations are likely to be consonant to their natural dispositions and talents. This work may also be of use to those who have just commenced their career as professional students of engineering. It embraces a larger field of operations, and a greater variety of departments than are to be found in almost any other work of the kind; and on this account the young engineer may advantageously learn from its pages the multiplicity of studies his profession calls on him to pursue, and thus at once teach him the necessity of applying his *peculiar* attention to some one or two, and enable him to choose for himself, either from natural preference or motives of expediency, which department of his profession he will make more immediately his own. This last class of persons seems to be the one for whom this work was especially designed by its author. It seems to have been intended mainly as a text-book for the junior students of engineering; but, viewed in this light, we think it has considerable faults. These may be comprised under two heads:—1st. It assumes too low an estimate of the preliminary acquirements, on the part of the student, in mathematics and general science; and, 2nd, its discussions are of too popular and shallow a character. It ranges over too large a surface, and nowhere penetrates to a sufficient depth below it to give the student any information that can be of *immediate practical* value. Of what use, for example, is it to an engineer to be told on what plan the ties and braces of a roof or other piece of frame-work should be arranged, if he is not at the same time instructed in the art of calculating the actual dimensions of the parts for any construction he may have under his care. We are aware that it will be replied by some, that a certain size is allotted to the book, or a certain length to a course of lectures; and within these limits the student must be taught engineering in all its integrity, in the full extent of its manifold ramifications. To this we reply, that, going over all these departments in the popular style we have been describing is *not* teaching engineering in any one of its phases, and that it would be much more philosophic, much more useful, and much more honest, at once to confess our incapacity to work impossibilities—to compress a very large science into a very small bulk. It would be much better, we maintain, to instruct the student thoroughly and practically in one or two departments of his profession. Such knowledge would be at once of service to him in the actual business of life; and, besides this, the habits of close and attentive study that are acquired by this method of education, are among the most powerful instruments in facilitating the acquisition of a similar knowledge of whatever other branch of his profession he may afterwards find to be of service.

If these views be correct, we cannot expect to find either regular treatises on Engineering, or courses of lectures on the same subject, which can be of much service in the education of engineers. The subject is too vast and too varied ever to be successfully treated in any one book or any one course of lectures: it is too large even to be *all* thoroughly studied by any one man. To be taught successfully, it must be broken into fragments. We conceive that it is inattention to this that has fully as much as anything else, rendered our institutions and professorships of engineering so totally inefficient, that attendance at any of them has become little short of a stamp of incapacity on any who may have been unfortunate enough to have been trained by their means—until at least the superficiality thus acquired has been thoroughly rubbed off by some of the more antique but more trustworthy methods of education. In short, we conceive that the best means of promoting the acquisition of a sound and practical knowledge of engineering may be comprised under three heads:—1st, a solid or substantial grounding in mathematics and general science, which must not be flimsy, although not necessarily extremely deep; 2nd, a most determined perseverance and industry, on the part of the student himself, in observing the construction, use, and arrangement of every mechanism, construction, or engineering operation with which he may come in contact, and a constant habit of preserving the principal of these observations by memorandums or sketches; and, 3rd, good and detailed descriptions and drawings of the best and most important engineering works hitherto executed, together with a judicious application of scientific principles to the analysis of such works, whereby the true sources of their excellence may be discovered, or their faults detected. The supply of the first of these requisites for the proper education of engineers scarcely comes within our province as journalists: the second depends exclusively on the student himself; but the third properly falls within the scope of this journal, and we hope that the efforts we have already made to supply our readers with detailed accounts of works of engineering, as well as exemplifications of the methods of applying scientific investigation to the elucidation of their principles will yet be much surpassed by our future performances. The operations of carpentry, building, mining, tunnelling, and all the multifarious processes that are usually directed by engineers, will supply ample sources for detailed descriptions and scientific discussions on the principles involved, the beauties displayed, and the imperfections existing in the various works that come under review; and if sometimes our criticism should seem prolix, or our scientific papers too minute or trifling, let it be remembered that the details of all works are the same, and that what is said of a brick, the method of joining two beams, or the qualities of the cement, in the most insignificant construction, applies with equal propriety to similar details in the most important. In this view the smallest matters may frequently deserve the gravest consideration; as what they want in individual importance they have more than made up by constant multiplication.

We have, however, allowed ourselves to be carried away from the consideration of Mr. Millington's work; but as it affords few passages favourable for extract, we must draw our observations, already sufficiently long, to a close, by saying that we think very highly of it as a popular treatise on the most prominent parts of the engineer's profession, but cannot recommend it as a text-book for the education of professional students. It might have been made much more useful for this purpose if it had been furnished with copious references to more voluminous works where additional information is to be acquired; but this, unfortunately, has been entirely omitted.

Art. XIII.—WOODEN BREAKWATERS.

Illustrated Description of the Buoyant Sheltering Sea-Barrier, for the Formation of Sheltered Floating Harbours of Safety. By Capt. Adderley W. Sleigh. Manchester: Simpson and Gillett. 1842.

Wooden breakwaters have latterly been viewed with a favourable eye by many intelligent persons. The agitation of the sea during a storm extends, it is maintained, to only a moderate depth beneath the surface; and any resisting body extending to that depth will necessarily resist its oscillations. Under these circumstances floating breakwaters become a very obvious application, and various forms of them have been proposed, but none have yet come into considerable use, though some are at present, we believe, in preparation. The breakwater of Capt. Taylor very closely resembles a ship without planks, the waves being supposed to be arrested and broken up by their impact on a multitude of timbers. The breakwater proposed by Mr. Sleigh resembles a ship with an inclined deck, the inclination being opposed to the waves, and serving as an object on which they may break. In both of these plans each individual structure is short, and a sufficient number of them are joined together to make a line or circuit of the required extent. The ships or fabrics are moored in the right position by strong chains: in Capt. Sleigh's plan they are all joined together by means of ball-and-socket joints at the extremities; while, in Capt. Taylor's plan, there is a considerable space left between each—the ends, however, being made obliquely, so that the opening is not at right angles to the face of the breakwater. There are, in our eyes, many objections to wood as a material for breakwaters, on account of the worm and dry-rot—zincked iron would be a greatly preferable material on many accounts; and vessels of the requisite form might easily be made of it. At the same time we are not prepared to recommend floating breakwaters at all; for the requisite experience has not yet been attained for coming to a sound opinion. We should like, however, to see them tried; they would be vastly cheaper and more quickly constructed than breakwaters of stone, and would have the great advantage of offering no impediment to silt or sand moving seaward, and which a stone breakwater would obstruct, to the obvious diminution of the depth of water. Tentative harbours of refuge might be formed of floating caissons; and if one situation were found ineligible, the whole harbour might easily be shifted to another.

We have no time to say anything of Mr. Sleigh's book further than that it is a most ludicrous production. Those of our readers who can laugh at magnificent fustian, may amuse themselves with the following extract from this orator's introduction:—

> "That the surest and most efficacious measures adopted by man to avert or avoid the incontrollable power of the Creator's works, are those which follow the law of Nature, is a fact known to every scientific mind; and that the most gigantic structures unskilfully opposed to them, crumble as futile efforts before their mighty influence, are circumstances also incontrovertible.
>
> "Having a knowledge of this, *transparent to our understanding*—with the wondrous, eternal, and sublime mechanism of the universe before our eyes, we feel that nothing is created by us,—that being the originators of no principle, we often, when right, unconsciously become the humble imitators of that which is so simple, yet so incomprehensible—of Omnipotent effects; hence, our feeble efforts to apply artificial ingenuity to the necessities of life, are permitted to succeed, and our exertions are crowned with a happy result."

We doubt not Mr. Sleigh thinks all this perfectly Johnsonian: we trust the laughter raised at his expense may succeed in undeceiving him; and we hope he will never again commit the egregious folly of attempting to be eloquent. The work is adorned by several plates—we suppose of Mr. Sleigh's own manufacture—the quality being about the same as that of his literature. Altogether the work is a very bad one, and its price is in the inverse ratio of its quality.

ART. XIV.—MAP OF THE CONTINENTAL RAILWAYS.

THE large map prefixed to our present Number, representing the lines of railway in Belgium, and those from Paris to Orleans and to Rouen, will serve to show the ramifications of the Belgian railroads, and the extensive range of railway communication that will shortly be established when the lines now in rapid progress towards completion are opened. Belgium takes the lead, and has from the central point, Malines, arms of iron extending to the frontiers of Holland, Prussia, and France, inviting co-operation, and one reaching to the North Sea, to facilitate communication with distant lands. When the railway between Liege and Aix-la-Chapelle is completed, a direct railway communication will be established between Ostend and Berlin, and thence to most of the German towns, and to the states of Northern Italy. The line connecting Lille and Courtrai is nearly finished, and that between Mons and Valenciennes is also in rapid progress. The map of the French railroads shows at a glance the importance of undertaking the northern route to Lille and Valenciennes, whereby a communication will be established between Belgium and the north of Europe with Paris, and thence to Orleans in one direction, and to Rouen in another. But a few links in the chain are now wanting to bring the principal cities of Europe within one-fourth the present distance of each other, in point of time; and as the vast importance of thus facilitating the intercourse of neighbouring states is beginning to be appreciated, we confidently anticipate that, ere long, not only will the projected lines of railway be completed, but that their ramifications will be extended to every part of the continent of Europe.

ART. XV.—REMARKS ON SHIPS' BOATS.

Remarks on the manner of Fitting Boats for Ships of War and Transports. By JOHN COW, of Her Majesty's Dockyard, Woolwich. Third Edition. London: John Weale. 1843.

THIS little work is a very excellent one, and deserves the attention of every shipwright. Mr. Cow is evidently one of that very rare class of practical men who unite originality with skill and judgment, and the improvement he has introduced into ships' boats are both numerous and important. By a very ingenious expedient he has contrived that a boat of a very moderate size shall be capable of transporting a heavy anchor or a large gun. This expedient consists simply in the application of an upright trunk to the boat, surmounted by a winch. The water rises in this trunk to the same level as the water outside, and a rope passes up through it to the winch. By this rope the anchor or gun is slung.

ART. XVI.—IRON STEAMERS.

WE mean on an early occasion to go into the question of the relative merits of wood and iron steamers. At present we have only to mention a circumstance which has just been brought under our notice, and which, in our judgment, tells considerably in favour of the latter variety. The circumstance to which we allude is the following:

On the occasion of the launching of the Prince of Wales, an iron steamer, mentioned in our last number as being then nearly completed, the vessel did not acquire an adequate impetus to carry her at once into the water, in consequence, we suppose, of the insufficient inclination of the ways, or it might be of the badness of the lubricating substance employed for the slides. When the stern part of the vessel, therefore, reached the water, she would not go any farther, a portion of the gravitation being then taken off, and she consequently was left with the stern in the water, and the bow upon the shore, the centre part of the vessel being unsupported in consequence of the floatation at the stern lifting the vessel from the cradle. This severe test the vessel stood without injury, and a tug-boat was applied to the stern to pull her off, the tide having, in the meantime, begun to run down, and acting with considerable force on the ship sideways. The vessel, we should have mentioned, was launched through an opening in the wharf-wall of just size enough to allow of the exit of the ship. When the tug-boat had nearly succeeded in drawing the vessel off, and only a small piece of the foremost part was left within the wall, the tow-ropes broke, and the tide, which by this time was running down with great strength, caught the side of the ship, which now, projecting as it did from the wall at right angles, lay right across the tide-way, and forced the ship round with irresistible force, bending the small piece of the ship which remained within the wall to a great angle with the rest of the ship, and dinging and twisting the plates in a most extraordinary manner. In spite, however, of this rough usage, which would most certainly have been fatal to a wooden ship, the iron vessel was not at all damaged, except being put out of shape, and by heating and adjusting the plates a little, they were put into their former forms without difficulty, and in a few days the shape was so restored, that no one could have known that anything had been the matter. We cannot conceive any severer test possible than that to which this vessel has thus been accidentally exposed, and we think those who hereafter navigate this vessel, must have a confidence in her strength and tenacity, such as any less cruel experiment must have failed to inspire.

ART. XVII.—THE STREET-PAVING ASSOCIATION.

The First Annual Report of the Practical and Scientific Association for the Promotion of Improved Street-Paving.

THIS is a very bad report on a very important subject. The necessity of an improved system of paving and cleansing the streets of London has long been felt, and this association was instituted to accelerate the accomplishment of that important object. It appears tolerably diligent in the work of inquiry and agitation, but all its efforts must be fruitless so long as it permits such contemptible reports to go before the world as that now under review. The report says next to nothing in a great number of badly chosen words, and has an air of vulgarity and insignificance such as could not fail to cast an unfavourable hue over any confederacy. In short, any one reading this report, who knew nothing of the parties, would certainly conclude that the association was composed of a congregation, not of patriotic gentlemen, but of intriguing shop-keepers.

The report enlarges much upon the advantages of wood-paving, which we think it greatly over-rates, and insists upon the importance of keeping streets clean; a maxim in which we concur. Our faith, however, we must confess, is staggered, when we are solemnly assured that the dust of the street occasions to Mr. Mivart an expense of £830 a-year in extra cleansing. Mr. Mivart could have his whole street swept daily for a smaller sum. Such over-done representations do an infinitude of evil to the cause they are intended to serve.

ART. XVIII.—THE SCREW PROPELLER.

WE participated in the prejudices most engineers entertained towards this contrivance, on its first introduction to practical use. It occurred to us that the oblique action of the screw would occasion a serious loss of power; and we had, therefore, great doubts whether the screw could ever become a rival to the ordinary paddle-wheel. The result of its application, however, has so entirely surpassed our hopes, that we suspect our original anticipations could not have been founded on any very stable basis; and, in short, we must confess that our opinions have undergone a great alteration. We are not sure that even yet we have got to the bottom of the subject; and, indeed, we are doubtful whether the materials even now exist for arriving at a safe and specific conclusion. Almost all hydrodinamical inquiries are more or less involved in mystery, and the action of the screw is one of the most complicated of their number; its theory is consequently still incomplete, and the means do not as yet exist for predicating, with certainty, the effects of certain arrangements. But enough has been elicited to show that the screw is destined to be a formidable competitor to the paddle-wheel; and will probably, before long, supersede it altogether. As a propelling agent it possesses many advantages which the paddle-wheel has neither realized, nor can possibly attain; while the loss from oblique action—the great objection to the screw in the minds of practical men—has been experimentally found to be either inexistent, or very insignificant.

Upon the whole, it appears to us that the screw has gained for itself a position such as the most sanguine of its advocates, a few years ago, could scarcely have expected; and even the most orthodox engineers must now be content to investigate its claims upon the public approbation, or acquire the reputation of bigoted and empirical practitioners.

But while we maintain that the screw has earned a title to a full and favourable trial, we by no means assert that it is a superior propeller to the paddle-wheel in all cases. Upon this subject our mind is not yet made up; nor do we conceive that, until greater experience has been attained, any satisfactory conclusion, as to which is absolutely the best propeller, can be arrived at. Our present purpose, therefore, is not to recommend the screw, nor to enter into any theoretical niceties, which could only needlessly complicate the inquiry, but merely to adduce such facts of practical moment as have come under our observation, and which appear to have an important bearing on the subject. The inutility of existing theories is well illustrated by the fact, which is now well established, that the speed of a vessel propelled by the screw is, under some circumstances, greater than if the screw were working into a solid. For this anomaly none of the theories accounts; and, in the present undeveloped state of the subject, the best way appears to be to set theory aside, and take facts, the soundness of which has been established by repeated trial.

The only trials that have been yet made of the comparative merits of the screw and paddle-wheel, where the boat and engine power was *precisely* the same in both cases, was in H. M. steamer "Bee," in the month of June, 1842. The result of several trials, at the measured mile, in Long Reach, showed the speed to be slightly in favour of the paddle-wheel, as follows:—

Paddle........	7·723
Screw	6·852

It was admitted by the Government officers that considerable allowance should be made towards the screw; first, in consequence of the boat having been constructed, in the first instance especially, for the paddle-wheels only, and consequently not so well adapted for the screw, owing to the light draught of water; secondly, that in consequence of the engine being also constructed purposely for driving paddles, a complication of gear work was necessary to transmit the power from the paddle-shaft to that of the propeller; thirdly, that although the lower boards of the wheel were unshipped when the screw was at work, neither the weight of the wheels, nor the resistance of the paddle-boxes, &c., &c., were removed from the sides of the boat. It also happened most unfortunately, that the day on which the screw was tried proved particularly boisterous, and the paddle-boxes being excessively large for the size of the boat, naturally caused a very considerable impediment, which would not have been the case had the boat been built expressly for the screw. The size of the "Bee" is about thirty tons, very heavily built. The engine is of ten-horse power, on the beam principle, by Messrs. Maudslay.

In the following experiments with her Majesty's packets at Dover, the Archimedes showed considerable superiority in point of speed, when the power and displacement of the several vessels were duly considered.* Each of the Dover vessels was fitted with engines by first-rate and experienced makers, all doing at the time the full number (and, in one or two cases, more) of strokes than they were rated at; whilst the engines of the "Archimedes" were making only about three-fourths of the number they ought, in order to have worked up to the power at which they had been estimated, viz., eighty horses.

The advantages of the screw over the paddle-wheels, in a heavy sea, were strikingly displayed in the trials with the "Widgeon."

A trial also took place between the "Duchess of Lancaster" and the "Archimedes" at Liverpool, June 5th, 1840. The "Archimedes" had taken in four days' fuel, whilst the "Duchess" had just come off from her usual voyage. In this case the "Archimedes" drew four feet more water than the "Duchess," which enabled her to keep in the eddy, whilst the "Archimedes" was compelled to keep in the strength of the tide. The result terminated slightly in favour of the "Duchess," she being about two lengths ahead in a run of three or four miles. The following are the dimensions of the two vessels, which are, as nearly as possible, the same in point of tonnage; whilst the cylinders of the "Duchess" are three inches larger than those of the "Archimedes."

Archimedes.	*Duchess.*
Diameter of cylinder, 37 in.	Diameter of cylinder, 40 in.
Stroke, 3 ft.	Stroke, 3 ft.
Tonnage, 237	Tonnage, 238
Draught of water, 10 ft.	Draught, 6 ft.
Length between perpendiculars, 107 ft.	Length between perpendiculars, 120 ft.
Beam, 21 ft. 10 in.	Beam, 20 ft.
Area of middle section, 141 ft.	Area of middle section, 100 ft.

The approximate results, with respect to the sectional areas of the vessels and engine power in different vessels, is pretty clearly shown in the foregoing table. In the "Great Northern," the screw surface, as compared with her middle section, and total displacement, is as follows:—The middle section, at 16 feet draught, is upwards of 540 feet, whilst the screw contains little better than 90 feet, deducting the shaft; and, with this small proportion, the vessel is moved by the screw through the water at the rate of nine statute miles an hour, whilst the "slip" amounts to only one-tenth. The total weight, or displacement of the ship, at 16 feet, is not less than from 1300 to 1400 tons.

The singular result of the performance of the screw, in propelling the vessel, with little or no loss of power, by "slip," is at present somewhat unaccountable; but it has been found that when the superficial area of the screw (taken as a disc) bears about the proportion of one-fourth that of the immersed section of the vessel, her speed will be quite equal, if not a little superior to that of the screw, supposing it to be working in a solid, and advancing, for each revolution, its own length or pitch. The angle depends slightly upon the kind of vessel to be propelled, the sharp light boat requiring a coarser pitch screw than a heavy ship or tug-boat. As a general rule, however, the screw whose flange, or thread, at the circumference, stands at an angle of 66 to 68 degrees with that of the axis, will be found to give off the best effect in practice.

With respect to the speed of the screw, it has been found that any increase in the number of revolutions produces a corresponding effect upon the speed of the ship, even from the lowest possible rate of the engine up to its maximum rate.

The number of revolutions, then, of any particular sized screw, is only limited by the power employed, as regards the speed of the screw over that of the engine, a multiple of four to one, may be taken as a general rule, with the ordinary condensing engine, going at 200 or 210 feet per minute.

It is somewhat difficult to determine precisely in what way the water is acted on by the screw when the vessel is moving rapidly through the water; but, from close observation, with models, in a glass trough, Mr. Smith has found that the water partakes but *very little* of the *rotative* motion of the screw, but is drawn in *on all* sides, from the circumference *towards* the centre; and as soon as it gets within its influence, is immediately thrown *aft* in a column, not exactly parallel, but more in the form of an inverted cone, the apex of which is in proportion to the diameter of the screw, occasioned, probably, by the disposition bodies have to fly off from the object on which they impinge at an angle equal to the angle of incidence. The screw, therefore, in its *entire* form, would produce this kind of action, from the circumstance that, if right angles were drawn from every part of it, a focus similar to that alluded to would be produced. It has been also observed, that when the screw has been working when the vessel is moored, the current of water which is thrown back assumes the form of an inverted cone. A similar effect is probably produced when the vessel is in motion.

From these circumstances, and others we might mention, it may be inferred that the action of the screw in the uncovered condition is very different to what it would be, if the screw were enclosed in a tube; first, because, if the screw were enclosed, the supply of water would require to enter at the end of the screw instead of the sides, and in flying off it would pass directly aft in a column, of the precise diameter of the tube. Mr. Smith has tried the effect of enclosing the screw in a tube, and finds it to be by no means favourable; the efficacy is nothing in comparison to that attained on the *common principle*. The most extraordinary effect of the screw as a propeller is still to be accounted for, viz., that, with the proportions before alluded to, it moves the vessel through the water as fast as if it were working in a solid. The cause of this anomaly, probably is, that as the vessel passes through, the water naturally closes in, as fast as the vessel goes, to fill up the vacuous space that must otherwise be left; in doing this the water apparently impinges upon the flanges of the screw, so as to oppose a greater amount of resistance to its backward stroke than if it were placed over the ship's side, in a position similar to that of the paddle-wheel. This closing in of the water produces a current following the ship, but whether this current is chiefly due to the particular form of the vessel, or to the capillary attraction of its bottom and sides, appears to have not yet been determined; but the latter, probably, is the more influential of the two. There is one peculiarity connected with the action of the screw, which appears deserving of notice. When the vessel is moved, the engine always makes full two-thirds the number of strokes it makes when the vessel is under weigh, and when under weigh the vessel almost invariably travels as fast through the water as if the screw were working in a solid. It therefore now only remains to discover the precise rate at which the eddy water follows up the vessel, in order to determine the exact amount of slip arising from the screw in reality, although *none* is discernible, when the velocity of the water over the ship's side is taken as the index of the rate.

Having stated that the water is thrown back two-thirds of the rate when at moorings, the remaining one-third may be imparted to the vessel when moving; so that if we presume the current to be flowing in at the rate only of six miles per hour, the effect of nine miles may be produced upon the vessel, allowing the remaining two-thirds, or six miles of *actual slip*.

Here, then, is a very important advantage over the paddle-wheel, and an advantage in placing the screw or other propeller in the dead wood, or run of the vessel. It is well known, that the slip of the best paddle-wheel, (say the old flat board,) *even upon sharp-built* vessels, amounts to fully a quarter; it therefore follows, that a similar result to that of the screw could only be obtained in the case of the paddle vessel being placed in a canal with two smaller channels, one on each side for paddles to work in. Suppose the speed desired to be twelve miles per hour, and the slip to be a quarter, it would be necessary to drive the wheels at the rate of sixteen miles; but in the event of the water in the two side canals being by some artificial means put into motion at the rate of four miles per hour, in the direction of the vessel, her rate would then be equal to sixteen miles per hour. There can be no doubt that this following current is first set in motion at the expense of a certain loss of power, from whatever agent the power be derived. The effect of the application of the screw in the dead wood is merely to reconvert this power, which would otherwise be thrown away, to beneficial use. One great advantage of the screw, as applied in the dead wood of the vessel, is the great facility it imparts in the operation of steering, owing to the rapid current of water past the rudder due to the motion of the screw. The velocity of this current is never less than six miles per hour, as might be expected from the allegation that the engine moves fully two-thirds its full rate, even when the vessel is stationary. The effect of the current of water on the rudder causes the vessel under all circumstances to have steerage way, and makes the rudder unusually sensitive, and unusually effective. But for this peculiar action, the circumstance of the propelling power being situated so far aft, would be highly disadvantageous in going head to wind, as the least yaw the vessel might make would cause the wind to act upon her side, and tend to turn her entirely round. Some paddle wheel steamers which have been lengthened by the bow, have been found to go much worse head to wind than before, simply because the elongation placed the shaft relatively too far aft, and paddle-wheels, or other propelling instruments, situated at the very stern would, of course, be still more open to this objection, if the effect were unredressed by some adequate provision. But the great power the rudder possesses in a screw vessel, even when the vessel is brought up by the violence of the wind and sea, enables her to keep head to wind better than any paddle-wheel vessel, and completely eliminates the objection we have mentioned. The objection at one time weighed considerably with us, and, we have no doubt, still weighs with others; but a closer observation shows that it is imaginary, and it has been abundantly refuted by experience. The "Archimedes," it has been found, will go head to wind when ordinary vessels of the same size and power are obliged to turn back.

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* The dimensions are given in Appendix D to Tredgold, page 21.

One of the most eminent advantages of the screw mode of propulsion, consists in the uniformity of the resistance, as compared with the paddle-wheel, and the consequent nice adaptation of the power of the engines to the exigencies of each particular case which consequently becomes attainable. In paddle-wheel vessels employed upon long voyages, great inconvenience is often experienced from the unequal draft of water at the beginning and the end of the voyage. At first, the paddles are so deeply immerged that the engines cannot reach their proper speed or efficacy, while towards the end of the voyage, the engines are disposed to run at an injurious speed, occasioning a great expenditure of steam, without imparting a corresponding impulsive effect. In scudding, again, or making way through a heavy beam sea, the motion of the engines is subject to great irregularities, one or both of the paddle-wheels being sometimes out of the water altogether. With the screw, on the contrary, the resistance is always very nearly the same, whatever be the circumstances of wind and water. A greater average efficacy is thus attained than when the engines are working sometimes above and sometimes below the most advantageous speed, and the engines are protected from the violent shocks and strains which flow from irregular movements. We are fully convinced, that many a break down and much wear and tear will be saved, by giving to the engines a more equable motion.

The superior applicability of the screw as an auxiliary power to sailing ships, is too obvious to need a word of comment; and it would be equally superfluous to dilate on the advantages of doing away with paddle boxes and paddle-wheels. We do not attach much importance to the superiority attributed to the screw for war steamers, on account of its being less exposed to hostile shot than the paddle-wheel. In either case, the chimney will be the part aimed at, and whatever carries *it* off will equally disable the vessel, whether she be on the paddle or screw principle.

Such are some of the advantages of the screw as compared with the paddle; and we must now enumerate some of the disadvantages. The chief of these is the difficulty of bringing up the speed to the point indispensable to the operation of the screw; and, indeed, there cannot yet be said to be any eligible contrivance for this purpose. In those cases in which the screw is applied merely as an auxiliary power, short-stroke engines, working at a high velocity, and coupled directly to the axis of the screw, appear to be applicable enough, and we do not see that this plan is open to much objection. But in other cases the intervention of cog-wheels or belts appears to be indispensable, and in a steam-vessel such appliances are open to much objection. The best mode at present in use of driving the screw, in those cases in which it is not at once connected with the engines, appears to be, by the use of cog-wheels, very nicely fitted, each tooth being divided into several pieces in the direction of its length, the pieces being each advanced a little before the other in the manner of steps. By this expedient the noise and friction are diminished, and the chances of fracture in the teeth made much less. Belts are a species of application in which we should not repose a particle of confidence, exposed as they must be at sea to spray, steam, and numerous other adverse influences to make them stretch and slip. The desideratum for the screw mode of propulsion appears to be a rotatory engine; but no *good* rotatory engine has yet been invented. Another evil to which, it occurs to us, the screw may be subject, is the subsidence of the water from the screw whenever there may be a heavy pitching of the ship. This is an evil, however, which we are bound to confess is only hypothetical: we have never heard that it had been found to arise in practice; and, if existent at all, it may manifestly be obviated by giving the vessel a greater rise of floor.

It has been doubted by some persons whether, although the screw is an eligible mode of propulsion for slow and heavy vessels, it can be rendered available for vessels which are required to move at a great speed. The experience of the last few months renders it unnecessary that we should say much on this subject. The "Napoleon," a war steamer, recently constructed for the French Government, has attained a rate of speed fully equal to that of the paddle-wheel steamers of her own class: and the "Mermaid," a river vessel, recently constructed by the Messrs. Rennie, has attained a speed equal to that of the fastest Thames steamers. The "Mermaid" is a faster vessel than the "Gem," the "Satellite," "Waterman, No. 9," "Red Rover," &c., and of equal or about equal speed to the "Eclipse," "Railway," &c., the fastest steamers on the Thames. It is questionable, moreover, whether the "Mermaid" is a vessel altogether well adapted for a high speed; and it appears likely enough that, under more favourable circumstances, a considerably higher velocity will be realized.

We cannot conclude these hasty remarks without saying a few words on the history of the application of the screw as a propeller. The application is not by any means a new one, and appears to have been known to the Chinese from time immemorial. In our own country the application has been often proposed and attempted; but up to the time that Mr. Smith took up the subject, nothing of the least practical moment had been achieved. To Mr. Smith, we do not hesitate to say, is due the great merit of having practically worked out the screw principle. Formerly it was a Polytechnic toy: he has made it a thing of practical value—a substantial, tangible, and useful invention. For all beneficial purposes, therefore, he is the inventor of the screw, and the credit and the privileges of that application are his indisputable right. There have been several imitations of the screw, we believe—to the end, we suppose, of escaping from the letter of Mr. Smith's patent. These, for the most part, consist of the employment of parts or segments of the screw, instead of a whole circle; and all of these plans we have yet seen are inferior to the screw itself. By dispensing with a portion of the screw surface, they make the employment of a large diameter indispensable; while the outline of the screw being broken, instead of being a continuous sweep, has a considerable tendency to lay hold of weeds, ropes, and any other thing that may be in the way. The various patents which have been recently taken out for inclined blades or segments of a screw as propellers, and situated in the dead-wood, are a manifest infringement of Mr. Smith's patent, and deserve neither encouragement nor toleration. Mr. Smith has brought this mode of propulsion to its present perfection at a great expense of time, labour, and money; and for others to be now suffered to come in, on the strength of some flimsy evasion, and dispossess him of any portion of his fame or profit, is not merely an act of injustice itself, but a precedent full of danger, not merely to our mechanical skill, but to our national prosperity. If inventors are led to believe that there is no security in the right of patents, improvement must languish, and finally die, and the supremacy of England will be buried in the same grave with the genius of mechanical advancement.

Art. XIX.—THE BUILDING ARTS.

We are obliged to postpone a real commencement on this subject. The large number of engravings we have given in the present Number is in part the cause of this; but we trust the postponement will have the effect of making our expositions all the more satisfactory when we once begin. Carpentry is the department that we shall probably commence with; but we have also a good deal to say about masonry, plumbing, and the other building arts. We are sensible of the importance of some practical dissertations on these subjects, and will overtake them as speedily as we can.

Art. XX.—METROPOLITAN IMPROVEMENTS.

Mr. Loudon has recently called the attention of the public to the importance of improving the arrangement and management of the metropolitan cemeteries, and since that time he has brought forward a number of important suggestions for the improvement of the parks. It is impossible for us to enumerate here all of these suggestions: for these we refer our readers to the Gardeners' Magazine, contenting ourselves with the following exposition of the mode of carrying out the proposed improvement of the Serpentine:—

> "A very great improvement to Kensington Gardens is now being made by enclosing a piece of waste ground, hitherto the receptacle of the worst kinds of filth, at the upper end of the so-called Serpentine River. By means of this addition the termination of the water might be very effectually and picturesquely concealed; and, instead of the hideous cast-iron fountain, a cascade from some masses of rock-work, or from the abrupt termination of a ruined aqueduct, might deliver, as a

waterfall, the same quantity of water which now flows from the fountain. We do not pretend to say that artificial rockwork, or the remains of an aqueduct, will not be works of art as much as the cast-iron fountain; all that we contend for is, that they will be works of art more in accordance with the surrounding scenery, and such as will not shock the feelings of persons possessing taste in landscape.

"It will be observed that we propose to widen the river in several places, and to introduce islands, so as to give it the only character adapted for still water, viz., that of a lake. On some of the spots on which islands would be formed there are already large trees, and on others we would plant low growths, such as rhododendrons, azaleas, &c., leaving glades of turf; and some of the islands should be almost entirely without trees and shrubs, so as to harmonise their surface with that of the Gardens generally. The margins both of the islands and the boundary shores we would vary by coarse gravel, blocks of stone, &c., so as to be more in accordance with nature, and to produce a better harmony of colouring. At present the grass grows to the very edge of the water, which is always unnatural, and produces a cold and monotonous effect. In this respect, the shores of the water in St. James's Park are much better managed.

"The management of the banks of pieces of made water is very seldom artistical. The object, in such a case as that before us, is, or ought to be, the imitation of the banks of a natural lake, and supposing it to be in a similar situation to that in which the artificial lake is placed; the imitation, in this and in all similar cases, being such as never to be mistaken for wild nature. It is of great importance to keep this last principle constantly in view; because it is the carrying of it out which constitutes a piece of natural-looking water in a pleasure-ground a work of art. In such a situation as that in Kensington Gardens, a natural lake may be supposed to have the banks clothed with aquatic plants, such as reeds, rushes, &c., so as to give them a marshy character; to have them broken by the treading of horses or cattle approaching to drink; or comparatively firm and smooth, with grass growing down nearly to the water's edge, but still separated from it by a line of shore occasioned by the varying height of the water. Here, then, are three distinct characters which may be imitated by art, and that in such a manner as that the imitation shall not be a fac-simile of nature, but a resemblance of it. In the first case, cultivated aquatic plants are to be employed instead of water-weeds; in the second, firm and dry warm-coloured broken ground is to be substituted for a poached surface; and, in the third case, the separating line between the water and grass is to be coated with coarse gravel or small stones, with, perhaps, occasional blocks connected with shrubs, so as to give a character of firmness, and introduce a warm colour between two cold colours."

We trust to see these and Mr. Loudon's other improvements speedily carried out. We know of no suggestions on such subjects of equal judiciousness, or any which have been advocated with more temper and ability.

ART. XXI.—THE SOCIETIES.

Society of Arts.—At the meeting of this Society, on the 24th ult., a paper was read from Mr. J. Lee, on a safety railway-carriage. Mr. Lee proposes to have bearers for the axles, and to provide all the carriages of a train with breaks to be worked by steam. For this purpose a steam-pipe, with a universal joint, is to run along all the carriages, and to be connected with the boiler, so that when occasion requires, the engineer may turn the steam into the pipe, and by that means put down all the breaks nearly at the same instant.—On the 31st ult. the principal subject of interest was a description of Mr. Stephens's life-preserver, intended to be used in cases of accident at sea. It possesses the advantages of greater portability and of more ready adaptation to circumstances than the life-preservers previously constructed. It consists of a hollow sphere of sheet tin, or other metal, cased with cork, and quilted over. To the metal globe are soldered eyes, through which ropes are passed, and projecting pieces of cord, or other material, are fastened to several parts of the apparatus, whereby a man in the water, to whom it might be thrown, may readily take hold.—A model in glass of Mr. Defries's dry gas-meter was exhibited, and an explanation of the principle of its action was given. The apparatus is hexagonal, and is divided within into several compartments, through which the gas passes from the receive-pipe to the burners. The apparatus is complicated, and its action would be difficult to describe without extending our notice beyond ordinary limits. We must content ourselves with stating that the gas, in passing through the different internal chambers, and through valves, indicates, by means of a hand on a dial, the quantity consumed. We understand that the advantage of Mr. Defries's metre has been proved by extensive applications of it in various warehouses and public buildings. One advantage of a dry metre is the avoidance of the absorption of moisture by the gas, and the consequent deposition of water in the pipes.—At the meeting of the Society on the 7th instant, Mr. Austin's plan of raising sunken vessels was described. It seems to differ little in principle from the ordinary mode of uplifting ships by the superior buoyancy of air. Mr. Austin proposes to pass a chain round the vessel, to which chain are attached a number of air-cases. When the chain is secured, the air-cases are inflated by means of a powerful pump, and they are made of sufficient size to raise the ship from the bed of the river.—The annual meeting of the Society was held on the 19th inst., when Prince Albert, who has been recently elected President of the Society in the room of the late Duke of Sussex, distributed the medals awarded to the successful exhibitors. It was stated in the report, that, since the formation of the Society of Arts in 1747, the sum of £100,000 has been expended by the Society for the encouragement of the industrial and the fine arts.

Ashmolean Society.—At the meeting of this Society at Oxford, on the 29th ult., Dr. Buckland read letters he had received from New Zealand, mentioning the discovery of the bones of a bird of most gigantic proportions, which appeared to have been recently deposited. It is conjectured the monster may still exist in the unexplored parts of the island; especially as a recent traveller reports to have seen a bird that stood about sixteen feet high; to a bird of which size the largest of the discovered bones must have belonged. If the traveller's tale be true, we may expect to have realized in our days the wondrous narration, by Marco Paulo, respecting the "rock" of Madagascar, which he avers to have had such power of wing, that it could take up an elephant as easily as an eagle carries off a mouse!

French Academy of Sciences.—At the sitting of the Academy on the 5th inst., the results of some experiments, by Messrs. E. Millon and Reisset, on the chemical phenomena due to contact, were made known. In their experiments the curious, and hitherto unexplained property which spongy platinum possesses of facilitating chemical combinations, was examined in a variety of ways, and on many substances. Wax, when in contact with spongy platinum, burned slowly at the temperature of boiling water; and the combustion was complete at 360° of Fahrenheit, which is 500° below the heat at which hydrogen gas ordinarily burns. In another experiment, two tubes, containing equal quantities of nitrate of silver, were put into a sand-bath, in one of which tubes spongy platinum was inserted. The nitrate of silver, in contact with the platinum, was found to be completely decomposed long before decomposition commenced in the other. Charcoal and pumice were also found to facilitate chemical action, but not so powerfully as the spongy platinum.—At the same sitting a communication was read from M. Pereyra, who professes to have discovered a cure for consumption in cod-liver oil, accompanied by tonics and strengthening regimen. He states that he has adopted this treatment in 362 cases since 1835; and in 242 he has effected perfect cures.—At the sitting on the 11th inst. a communication was made by M. Pelouze respecting the assimilation of food by herbivorous animals. According to the recent theory of M. Dumas, animals find already prepared in vegetables the matter which subsequently forms part of their flesh, fat, &c. This theory, which is opposed by Liebig, M. Pelouze undertakes to refute, and, in conjunction with M. Gelis, he has succeeded in producing from vegetable products apparently the most remote from fatty matter, such as starch and sugar, a quantity of butyric acid. M. Pelouze exhibited the results of his experiments, and filled the chamber with the fumes of butter produced by chemical agency from starch.—M. Arago announced that M. Matthiessen had succeeded in reducing the aberration of sphericity in lenses of small focus; an improvement which was expected to be of great utility in making optical instruments. M. Arago also announced the discovery of a mine of mercury in the neighbourhood of Toulouse.

Institute of British Architects.—At the meeting, on the 12th of June, Mr. Britton read a paper, and made comments, on porches, and particularly described that attached to the ancient abbey church of Malmsbury, Wiltshire. Mr. Britton's observations were as follows. This church, at the epoch of its erection, must have excited the admiration, as well as adoration of the religious enthusiast, the wonder of the passing observer, and the studious attention of the monastic architect. Considering that the Normans, in their own country, built but few porches, and that they are of rare occurrence in England, before the commencement of the 13th century, that at Malmsbury is not more remarkable than it is interesting. I believe it to be unequalled in Europe; and, whilst it is original and admirable, as an architectural design, it is entitled to the most critical study of the antiquary, and the professional architect. The plan and views which were exhibited show the form, as regards its arrangement on the ground, with its design and details, in composition and execution. Projecting from the wall of the south aisle of the nave, at the distance of two severies, or divisions of the western front, it presents a large mass of building, plain and unadorned, externally, but abounding with elaborate mouldings, arches, and arcades, with a profusion of sculpture, internally. Mr. Britton then referred to, and described the peculiar features and characteristics of the porch, which require illustrations to explain. It is fully described and delineated in the first volume of the author's "Architectural Antiquities," and his volume of "Chronological Architecture." The reader is also referred to the "Dictionary of Architecture and Archæology of the Middle Ages," for an Essay on Porches and Porticos.

Institution of Civil Engineers.—June 13th.—A paper was read from Mr. George Hurwood, Assoc. Inst. Civ. Eng., describing the method by which he got rid of an accumulation of water from the warehouses, cellars, &c., in the lower levels of the town of Ipswich, caused by the formation of the new dock at that port. The communication was accompanied by a plan, showing the dock and part of the town, together with several ingenious tide-flaps, valves, drain-boxes, &c., with the different levels of the places affected, to discharge the water from places with such varying levels. The paper describes a skilful and novel combination by which the sewers become reservoirs, so that a continual free discharge is secured: although the tide rises far above them, the outlet, for a considerable period of time, prevents any discharge. The method was designed and executed by the author, and has been in operation for a considerable time: it is found perfectly successful, and received the approbation of the meeting.—A paper, from Mr. Thom, Mem. Inst. Civ. Eng., on the formation of embankments for reservoirs to retain water, was read. After describing a model designed to show that the proper slope of such embankments should not be less than three to one on the water-face, and remarking that waves act more severely on the pitching or paving of the inner face in proportion to the steepness of the slope, the author proceeds to describe in detail the mode of forming embankments by excavating the foundation to such a depth as was found firm, and capable of preventing the passage of water, then by spreading alternate layers of puddled peat, or alluvial earth and gravel, beating them together with wooden dumpers until they are completely mixed: the slopes are covered with a puddle made with small stones or furnace cinders mixed with clay, so as to prevent the possibility of moles or other vermin penetrating into the embankment. He condemns the practice of forming embankments with puddle trenches, and refers to many made by him at Greenock, Paisley, and elsewhere, having stood the test of time without injuring them; and particularly mentions one at Greenock having remained firm and sound after a rush of water passing over it a height of ten feet, caused by the breaking down of another embankment situated about one hundred and fifty yards above it. He recommends, instead of the puddle trenches, that the whole of the inner part of the embankment should be made water-tight during the formation of it, by which means it will more effectually resist either any casual injury, or any effect of the swelling of the puddle-trench. The paper was entirely of a practical nature, and was intended to illustrate the author's peculiar views founded on his great experience.

June 20th. From among the numerous presents which were announced, was particularly noticed another contribution of books selected by Mr. R. Young from the library of his brother, the late Dr. Young; and a gauge for measuring a small amount of pressure of gas, &c., by Mr. A. King: this machine appeared extremely simple, accurate, and not liable to get out of order.—A paper, by Mr. John Taylor, Mem. Inst. Civ. Eng., described a machine for raising and lowering the miners in the deep mines of Cornwall. It is composed of two wooden rods, with platforms fixed at given distances upon them, and placed either vertically or following the inclination of the vein, as is the custom for the shafts in tin and copper mines. These rods receive an alternating motion from a steam engine; and, at the moment of pause caused by the cranks passing over the centres, the men step from one platform to another, and thus either ascend or descend in the pits without fatigue. By the usual mode of arriving at or leaving their labour, the workmen are exhausted by traversing ladders to the depth, frequently, of more than 200 fathoms; and their health has been found to be seriously injured. This machine has been successfully at work in the Tresavean mine for upwards of a year, and its use will, it is hoped, be soon extended.—A short description was then read of an ingenious annular valve, constructed by Mr. Hosking, of Perran Foundry, Cornwall, and said to be in use with advantage at the Vauxhall waterworks, and attached to some very large engines for draining fens.—A paper, by S. C. Homersham, Assoc. Inst. Civ. Eng., described the original leather-flap valves generally used for pumps, their defects, and the modifications which had been introduced in them: it then gave the reasons why the self-acting double-beat valve of Messrs. Harvey and West needed some alteration for certain peculiar situations; and then described the three-ring pyramidal valves which had been introduced so successfully by Mr. J. Simpson at the Chelsea, Lambeth, and other waterworks, and which had been also adopted by other engineers. It was stated that, by increasing the area for the passage of the water, and properly proportioning the weight of the valve-rings so that they should close before the engine returned upon its stroke, according to a rule which was given, all the concussion formerly objected to in the valves was done away with, and their durability was materially increased. The paper entered very fully into the details of the construction of the valves, and their qualities, and elicited a very animated and useful discussion. The subject was illustrated by numerous drawings and models.

The meeting was adjourned until Tuesday evening, the 27th inst., when the following papers will be read:—

No. 636. "On the present state of the Streets of the Metropolis, and the importance of their amelioration." By C. Cochrane.

No. 629. "On the relative merits of Granite and Wood Pavements, and of Macadamised Roads." By D. T. Hope.

No. 630. "Description of the large 'Auger' or 'Miser' used for sinking wells through difficult strata." By T. Clark, Assoc. Inst. Civ. Eng.

No. 614. "Description of a Roof erected at the Chartered Gas Company's Works, Westminster." By F. J. Evans, Assoc. Inst. Civ. Eng.

No. 590. "On the Pressure and Density of Steam, with a proposed New Formula for the relation between them; applicable particularly to Engines working with high-pressure steam expansively." By W. Pole, Assoc. Inst. Civ. Eng.

Art. XXII.—INVENTIONS OF THE MONTH.

Vacuum Voltaic Battery.—A new kind of voltaic battery has been submitted for approval to the French Academy of Sciences, in which it is proposed to increase the power of the battery by causing it to act in a vacuum. The arrangement of zinc and copper, or of zinc and platinized-silver plates, is nearly the same as in an ordinary series of positive and negative plates, but the whole is inclosed in a strong case that will resist the pressure of the atmosphere. The air is then exhausted, and the hydrogen gas resulting from the decomposition of the water rises to the surface as soon as it is formed. By this means the surfaces of the plates are kept constantly free from globules of gas, and are exposed fully to the action of the acidulated agent. It is the adhesion of the generated gas to the plates that diminishes the action of ordinary voltaic batteries when only acidulated water is employed as the stimulating agent, but by the arrangement now proposed the gas is quickly and effectually removed without the necessity of employing the solution of a metallic salt to absorb it.

India Rubber Paper.—India rubber is now applied to nearly every purpose; from the paving of streets to the corking of bottles. A Frenchman has recently extended its use to the manufacture of paper! It is not, indeed, intended at present to supersede common writing paper; the inventor limits its application to engravings. The principle of the invention is to cover paper with a transparent caoutchouc varnish, by which means, it is asserted, the ink in the lines of the copper plate is more effectually extracted during the printing process, and the engraving is much more durable. For maps intended for sea-service such paper may be an improvement, as it would not be affected by the saline moisture.

New Processes for Manufacturing White Lead.—Two new plans for the manufacture of white lead have been announced; one of which has been patented in this country by Mr. John Mullins, surgeon, of Battersea, the other is the invention of M. Gannal, also, we believe, a surgeon, and, if we mistake not, the inventor of a new process of embalming which was lately much talked of. In Mr. Mullins's process, the oxidisement of the lead is facilitated by forcing currents of air, or of oxygen gas, through the melted metal; and it is subsequently carbonised by exposing the oxide thus obtained to the vapours of vinegar and to carbonic acid gas. M. Gannal proceeds by means of mechanical division to expose a large surface of the metal to the action of atmospheric air, and diluted nitric acid. The oxide of lead which is thus procured is exposed to carbonic acid gas, and the white carbonate of lead is subsequently dried by means of pressure and hot air. White paint made from lead thus prepared is said to last much longer than the ordinary paint: the process has also the important advantage of being less injurious to the workmen.

Preservation of Meat.—The important object of preserving meat from putrefaction is said to have been attained by M. Dussour, a Frenchman. The preparation he uses is a *syrup of iron*, composed of a solution of iron sweetened with sugar. The meat dipped in this syrup, and then dried, is said to resist the putrefactive action of warmth and air, and to undergo no change under circumstances which completely destroy meat not so protected. By merely washing off the varnish of sugar and iron the meat is ready to be cooked, and is represented to be as fresh as when it was dipped in the preparation. The proportions of the ingredients are not stated, nor is the particular salt of iron indicated; but if the composition be as simple and as effective as the French journals assert, M. Dussour has conferred a great benefit on mankind by his invention.

Improvements in the Electrical Telegraph.—Some discoveries have been made by Mr. Bain, in the progress of perfecting his electrical telegraph, which open a new field for inquiry, and show most forcibly the universality of electrical agency. Having ascertained that the moisture of the earth is sufficiently conductive of electricity to complete the circuit of a voltaic battery without the necessity of employing two wires, Mr. Bain conceived that the earth itself might be converted into a voltaic battery, by placing a zinc plate and a copper plate in moist ground at a great distance apart, and connecting them by one insulated wire. Experiments were made on a large scale, and were found to answer perfectly. A copper plate was placed in the earth, in Hyde Park, at a distance of one mile from a similar plate of zinc, and the electricity produced was sufficient for the performance of the ordinary electro-magnetic experiments; the moisture of the earth being the only liquid exciter employed. This important discovery Mr. Bain has applied very successfully for the improvement and simplification of his electrical telegraph. He now proposes to make all the requisite signals by the use of a single wire, connecting plates of positive and of negative metal at the two extreme points of communication. We have been favoured by Mr. Bain with a minute explanation of his apparatus, but it is perhaps sufficient to state at present the general principle on which it is constructed. The telegraphic apparatus at each station is worked by powerful springs or weights acting on series of wheels. Dials marked with corresponding figures and letters, to which insulated hands point, are also fixed at the stations. When metallic communication is made between the hands and the dials, the voltaic circuit is perfect; but as soon as the connection is broken, at either station, the clock-work machinery is put in motion by the removal of a stop, and the hands on each of the far-apart dials turn round and point to corresponding figures and letters. When the required symbol is indicated by the hand, the operator stops it, and renews the metallic connection. The machinery of the apparatus is so ingeniously arranged, that during the instant the hand is stopped, it *points* the symbol at each terminus of the telegraph. The connection is again broken, the hands of the dials go round as before; when stopped, the machinery repeats the pointing process, and the whole telegraphic dispatch is thus transmitted. The *terrestrial voltaic battery* will keep in action without any expense for an indefinite length of time. Messrs. Wright and Bain, the patentees of the invention, are, we understand, in treaty with the Government to construct a telegraph on their principle from the Admiralty to Portsmouth.

Art. XXIII.—ANALYSIS OF BOOKS.

A Steam Manual for the British Navy. By W. J. Williams, Capt. R.N.
Portsea: W. Woodward. 1843.

This is a very useful little work. It is a short, lucid, and practical summary of the chief points with which the captains of steam vessels ought to be familiar, and is well and modestly written. The work is, of course, a mere compilation, and, for the *Artizan*, can have but little interest or novelty; but the compilation is well executed, and the work is very well adapted to the purpose for which it was written.

Art. XXIV.—MARVELS OF THE DAY.

"The Blackwall."—This vessel, which has been laid up for some time, having a new boiler put in, has just been started; and is, at the present moment, the fastest vessel on the Thames. The vessel is propelled by a single engine, of the steeple construction, made by Messrs. Miller, Ravenhill, and Co.; and the new boiler is by the same eminent firm. It is somewhat of the locomotive construction, the smoke passing through the tubes. There is an abundance of steam; and, we understand, but a very small consumption of fuel in proportion to the steam expended. Common coal is burned on the fire-grate, and there is no expedient for consuming the smoke. No inconvenience has been found to result from the use of common coal; nor has there been found to be any accumulation of soot in the tubes. There are, however, doors opposite the tubes, to enable them to be cleaned out easily. The locomotive form of boiler appears to be coming more and more into use for steam-vessels. It is the lightest, safest, most economical, and, in the case of river vessels, in every respect the best.

From our own Correspondents.

Manchester.—*Large Chimney.*—Mr. Brockbank has just finished the erection of a large chimney, at the works of Messrs. Dewhirst and Co., Adelphi, Salford, which is stated to be the highest in this town. It is a plain circular shaft, on a square base, of fifteen yards high, and seven yards square. The total height of the chimney, from the foundation, is eighty-one yards; and the thickness of the wall, at the bottom, three feet. The external diameter at the top is ten feet, and the thickness of the wall ten inches, the aperture being estimated to be of sufficient area for steam engines of about 400 horses power. The principal singularity of this chimney is, that although such structures are usually built here in great part or wholly of brick, this one is constructed entirely of stone, of which it contains about 1700 tons. This material has, we understand, in this case been found to be somewhat cheaper than bricks; whilst, for durability and appearance, there can be no comparison.

Railway through Manchester.—The formation of the Hunt's Bank junction line, which will speedily connect the Liverpool and Manchester, also the Manchester and Bolton railways, with the Manchester and Leeds line, is proceeding with considerable activity. That portion of the work belonging to the latter Company, which terminates with the new bridge over the Irwell, at Hunt's Bank, also now in course of erection, is expected to be opened before Christmas. The execution of the other portion of the junction line, undertaken by the former two Companies, on the north-west bank of the Irwell, and which is carried over several of the principal streets of Salford, of course progresses more slowly. This part of the work includes a stupendous *iron* colonnade and viaduct, about 250 yards in length, designed by Mr. John Hawshaw, C. E. This colonnade is now nearly completed, and has a novel and powerful effect, from the very massiveness of the style of architecture adopted, which is of the Egyptian character,—a style well adapted for structures of this kind; and equally suited, perhaps, to the present great want of the iron trade, *consumption.* The columns are about four tons each, and stand in double pairs, at intervals of twenty-eight feet, each pair supporting the railway by main cross-beams of six to seven tons each, on which rest the longitudinal beams, varying from three to six tons each; the spaces between the latter being filled in with brick arches. The chasteness in the design is increased in effect by a deep entablature, or screen, eleven feet high, and seven feet above the rails, formed of cast iron plates, the only ornament on which is a pannel over each pair of columns, containing two figures of a winged serpent. The viaduct is twenty-four feet wide, and eighteen feet above the pavement of the streets. The iron work, of which there is about 1000 tons, has been executed by Messrs. Ormrod and Sons, of the St. George's Foundry, Manchester.

Steam-boiler Explosion.—A large wagon-shaped boiler, of about twenty-four horse power, burst, on the 31st ult., at the Medlock Vale Dye-works, near Manchester, belonging to Messrs. Otho Hulme and Sons, by which two of the workmen were scalded, one of them so severely that he died the same day. The accident occurred about ten o'clock in the morning, when the works were in full operation. The cause of it has not been ascertained, except that the boiler was a very old one, having been in constant use for upwards of twenty years. A large rent was made on one side of the bottom, about two feet long, and nearly a foot wide, through which the water rushed into the furnace, and lifted the boiler up with such violence as to force the roof off the dye-house in which it stood, rupturing the internal cross-stays of the boiler, and causing the sides to bulge out considerably. The boiler was furnished with the ordinary so-called safety valve, and the pressure of the steam was ascertained, about two minutes before the accident, to be only two to three pounds to the square inch. The iron, in the part that gave way, was nearly as thin as a sixpence. A.

Liverpool, June 24th.—The Collegiate Institution has just been opened for the exhibition of works of art, and the display surpasses anything I have met with in London, in either the Polytechnic Institution or Adelaide Gallery. There is not so abundant a display of steam-engine models as in the former of those favourite resorts; but in many other of the departments of the arts there is a far more attractive assortment. There are a vast number of rooms devoted to this exhibition. In the lower rooms are chiefly deposited examples of stoves and grates, marble chimney-pieces, agricultural implements, and other weighty articles. Above stairs, Paisley shawl, carpet, and other looms, are to be found at work. There is also a type-composing and type-distributing machine, and a number of small steam engines and other mechanisms, which are kept in motion by a steam engine situated in some other part of the building. In a central room is a basin of water with small steamers plying on its surface. Of these, the model of a screw steamer, after the plans of Mr. Grantham, is the most conspicuous. This vessel is proposed to be driven by small oscillating cylinders acting immediately on the shaft without the intervention of any gearing. A small steamer has been constructed on this principle, and tried on the Mersey. She is reported to answer exceedingly well.

The theatre of the Institution is occupied by a bad panorama of the Eglinton Tournament. The upper part of the building is devoted to the exhibition of paintings, of which there are a great variety. Some of these pictures were exhibited in the Mechanics' Institution last year.

This exhibition is certainly very creditable to Liverpool, and is calculated to lend a fresh impulse to the cultivation of the arts. The number of visitors has hitherto not been so great as might have been expected, or as the attractions of the exhibition deserves.

Q.

MISCELLANEA.

A small iron steam-boat has been appointed to ply on Loch Katrine during the summer months. It is only about six tons in weight, engines and all, has no deck, nor any part of it covered in except the engine, which is of six horse power.

We learn that the medical commission, sent by the Russian Government into Egypt, sent home a report, in which they stated that the experiments applied to the purification of objects infected with the plague, by means of caloric, have been entirely successful: they express the hope that they shall establish, by further experiments, the efficacy of the same agent as a specific means of destroying the miasma.

The French papers mention that M. Botta, the French consul at Mossoul, commenced, twelve months since, making excavations on the site of the ancient city of Nineveh, situated on the Tigris, opposite the present town of Mossoul. The walls are still traceable, as also some huge piles of bricks, which served as foundations of the palace of the kings of Assyria. In one of the piles he found the remains of a palace, the walls of which are covered with bas-reliefs and inscriptions in cuneiform characters. This is the more important, as no sculptured Assyrian monuments have been hitherto discovered. The Government has sent M. Botta a sum of money to forward his undertaking.

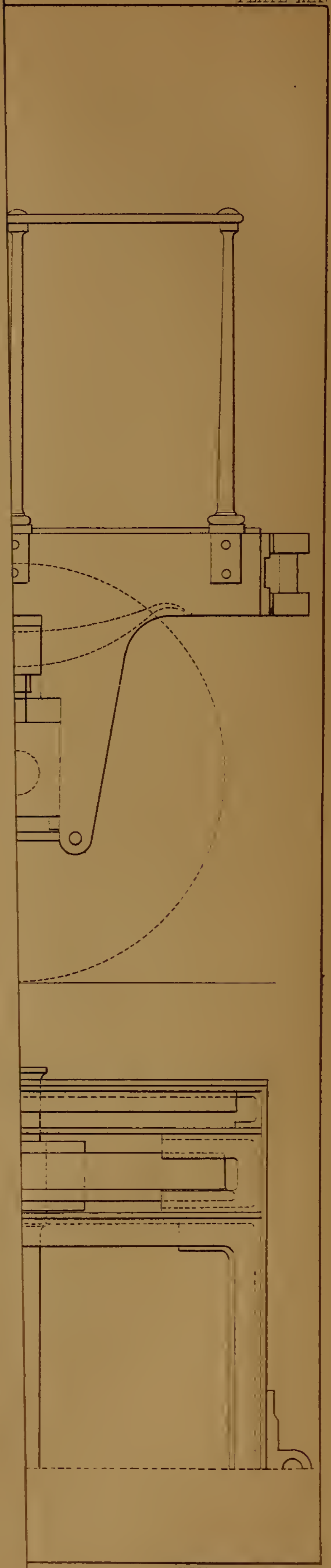
Royal Commission of Fine Arts.—Whitehall, 16th June, 1843.—Her Majesty's Commissioners hereby give notice:—1. That whereas carve work in wood will be required for various parts of the New Palace at Westminster, and in the first instance for the doors of the House of Lords, artists are invited to send specimens in this department of art, to be exhibited for the purpose of assisting the Commissioners in the selection of persons to be employed. 2. The specimens are to be sent in the course of the first week in March, 1844, to a place of exhibition hereafter to be appointed. 3. The specimens are required to be designed in general accordance with the style of decorations adopted in the New Palace. Outlines in lithography, showing the dimensions of the principal door of the House of Lords, may be obtained at the architect's offices in New Palace-yard. 4. Each exhibitor is required to send one and not more than two designs for an entire door, drawn to the scale adopted in the outline—viz., two inches to a foot; and one carved panel, or part of a panel and frame-work, not exceeding four feet in the longest dimension, representing a part of such design in the full proportion. The objects forming the details of decoration, in conformity with the conditions above expressed, are left to the choice of each artist. The material of the carved specimen is to be oak. 5. The invitation to send works for the proposed exhibition is confined to British artists, including foreigners who may have resided ten years or upwards in the United Kingdom. 6. Artists who propose to exhibit are required to signify their intention to the secretary on or before the 1st of January, 1844. By command of the Commissioners, C. L. Eastlake, Secretary.

Whitehall, 16th June, 1843.—Her Majesty's Commissioners hereby give notice:—1. That whereas various windows in the New Palace at Westminster will be decorated with stained glass, artists are invited to send specimens in this department of art, to be exhibited for the purpose of assisting the Commissioners in the selection of persons to be employed. 2. The specimens are to be sent in the course of the first week in March, 1844, to a place of exhibition hereafter to be appointed. 3. The specimens are required to be designed in general accordance with the style of architecture and decoration adopted in the New Palace. Outlines in lithography, showing the dimensions of the windows, may be obtained at the architect's offices in New Palace-yard. 4. Each exhibitor is required to send one and not more than two coloured designs for an entire window, drawn to the scale adopted in the outline—viz., two inches to a foot; and one specimen of stained glass, not exceeding six feet in the longest dimension, representing a part of such design in the full proportion. Such specimens of stained glass to be glazed up in lead, and framed in wood. 5. The objects forming the details of decoration may be either figures or heraldic devices relating to the royal families of England, or a union of the two, and may be accompanied by borders, diapered grounds, legends, and similar enrichments. 6. The invitation to send specimens for the proposed exhibition is confined to British artists, including foreigners who may have resided ten years or upwards in the United Kingdom. 7. Artists who propose to exhibit are required to signify their intention to the secretary on or before the 1st of January, 1844.—By command of the Commissioners, C. L. Eastlake, Secretary.

The Plymouth Breakwater Lighthouse.—This valuable addition to the public works is now fast approaching to completion. During the past week the third story of the building was completed, so that the oil-room, the store-room, and the living room are now up. The fourth room, which will be the sleeping apartment, is in a forward state, nearly the whole of it being dry set at the Breakwater quarries at Oreston.

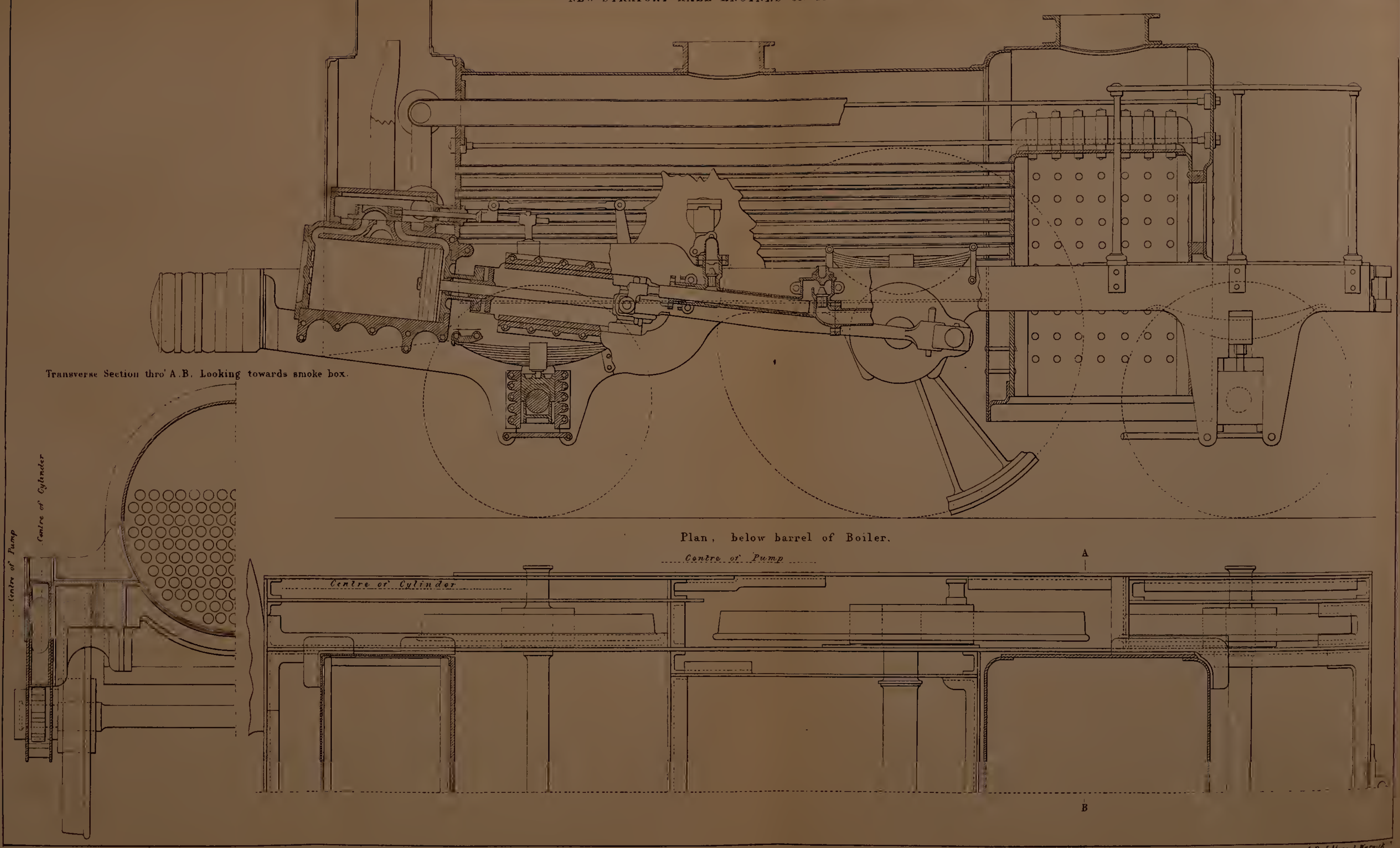
The art of working in bronze has been brought to such perfection and extent in France, that in 1842 Paris alone produced articles amounting in value to 30,000,000 francs.

Mr. Russell has invented a futile contrivance for ascertaining the saltness of water in steam-boat boilers, which he calls a salinometer. We may perhaps say something on the subject next month, if the scheme happens to be alive at that time. There are numerous inaccuracies in Mr. Russell's paper on the subject, which we shall then point out.



J. R. Jobbins, 3 Warwick

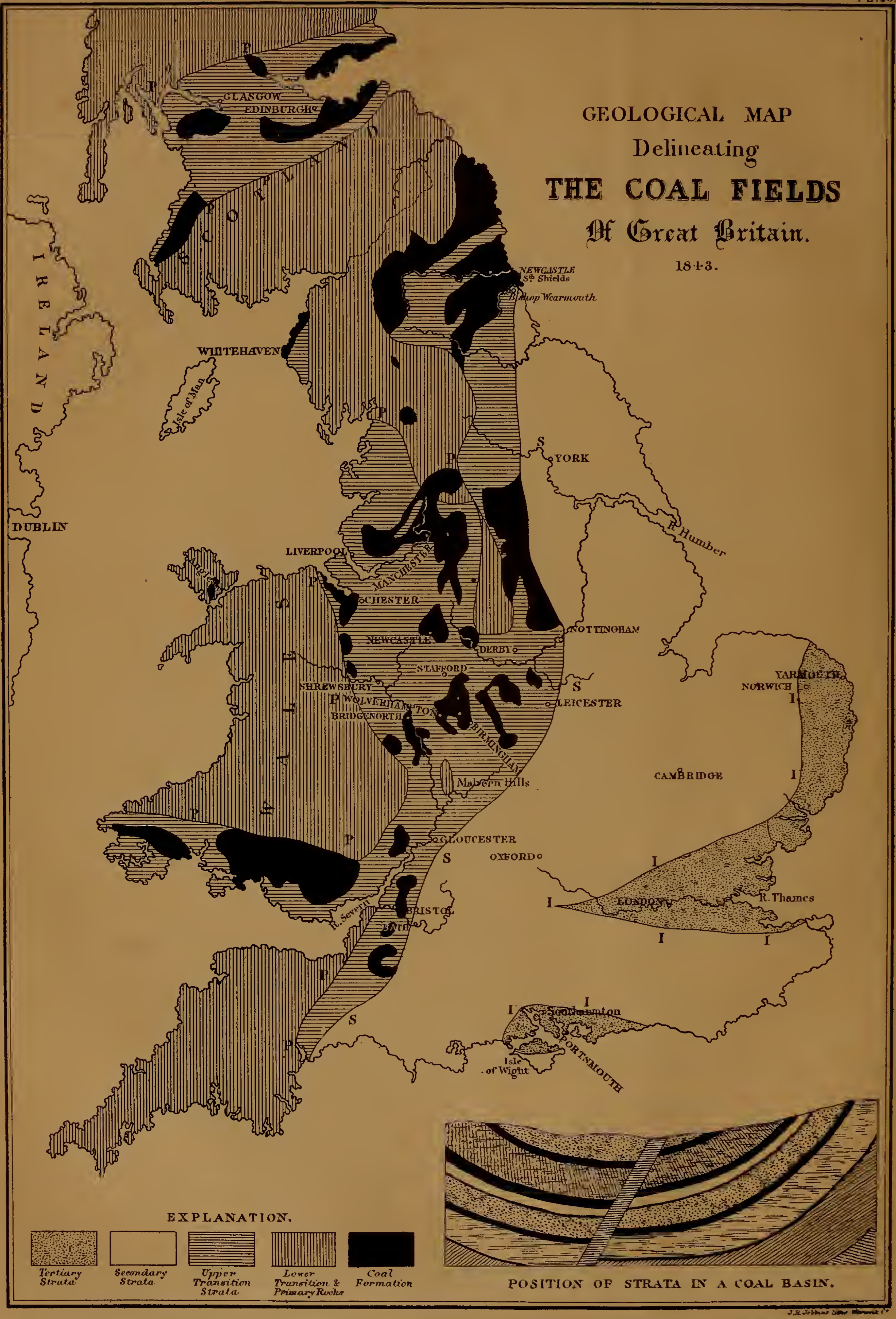
NEW STRAIGHT AXLE ENGINES ON THE GRAND JUNCTION RAILWAY.



Transverse Section thro' A.B. Looking towards smoke box.

Plan, below barrel of Boiler.

J R Jobbins, 3 Warwick



GEOLOGICAL MAP
Delineating
THE COAL FIELDS
Of Great Britain.
1843.

POSITION OF STRATA IN A COAL BASIN.

THE ARTIZAN.

No. VII.—JULY 31st, 1843.

Art. I.—COCKERELL'S LECTURES ON ARCHITECTURE.

DELIVERED AT THE ROYAL ACADEMY.

Professor Cockerell is, undoubtedly, a man of genius, and is, consequently, one of the least empirical of the present generation of architects. His sensibilities appear to be sufficiently active, at the same time that they are of the right description, and his taste is such as the discipline of study and experience, operating on a lively fancy, might naturally be expected to create. We are not, however, by any means satisfied that these high qualities shine out very prominently in the lectures now under review, and, indeed, we can hardly look upon those lectures as worthy of Mr. Cockerell's talents, or answerable in any considerable degree to his high reputation. There are some parts of them, no doubt, in which sound doctrine is very felicitously expressed, and certainly they exhibit much laborious research, and a familiar acquaintance with architectural technicalities. But in the philosophy of the art, they appear to us to be extremely defective, the doctrines propounded being often erroneous, and generally imperfect; while many of the elucidations are unintelligible, and others of them are very little to the purpose. It is upon architecture, as a fine art only, that Mr. Cockerell professes to treat; or in other words, upon those conditions of construction by which the quality of beauty is realized. Yet, upon this subject we do not find that anything has been advanced of the least interest or novelty, while we are inundated with descriptions of buildings of all countries and eras, from the times of Nash up to the times of Noah. We do not by any means allege that these historical disquisitions may not be all very useful and very attractive, or that Mr. Cockerell has not in many cases given them very well; but we do say that they have nothing to do with architecture as a fine art, and can in no wise elucidate the nature of architectural beauty. In short, it is very evident to us, that whatever else Mr. Cockerell may have done, he has not realized the object his lectures were intended to accomplish, and architecture as one of the elegant arts remains in just as much obscurity as if Mr. Cockerell had never undertaken to throw light upon the subject.

We are sensible, indeed, that such an undertaking is one of no ordinary difficulty, and demands from the critic corresponding indulgence. It involves a pilgrimage through some of those misty regions of metaphysics where the foot of adventure has never yet penetrated, and where the fire of his own genius is the only light which is left to the traveller to direct his footsteps. To make any progress, or achieve any discoveries, under circumstances so unpropitious, is a work deserving of no small amount of praise; and imperfect success, or occasional failure, may well be excused amid difficulties so stupendous. But our objection to Mr. Cockerell is not that he has fallen short of a full development of the more subtle elements of architectural composition, but that he has left that development unattempted; that, instead of courageously entering upon the steep and rugged paths which wind around the summit of the architect's Parnassus, he has loitered away his time among the flowery slopes and broadly beaten tracks which lie about its base. To this, indeed, we should have had no right to object, had he at the outset announced such to be his intention; had he told us, that he merely meant to describe the structure of different buildings, or the merits of different architects, the objection, that he had left the more recondite parts of architecture altogether unillustrated, would have carried with it not a particle of weight. But, when he avowedly sets out with the intent, not of descanting upon the history or details of architectural composition but of apprehending and showing up to us its vital essence, we do think we have reason to complain when we find that end not only unachieved but unattempted.

We are not sure, however, that even on any assumption of the purpose of these discourses, we should be able to praise them very highly. The material is for the most part good, but is very unskilfully put together; and each lecture, instead of forming a smooth and homogeneous whole, is full of breaks, and flaws, and inequalities, which reduce it to a heap of fragments. The lectures have no discoverable plan, and nothing is put in its right place; but a particular topic is capriciously taken up, capriciously dismissed, and as capriciously recalled; so that the reader never knows when any particular point has been disposed of, or whether what he is reading in one page may not be modified or even set aside by something to be met with in the next. In fact, these lectures more nearly resemble an assemblage of loose notes than anything else—they are merely the materials of lectures, not lectures of themselves, and have no more right to that appellation than a heap of bricks and timber has to the title of a house. We must, however, without further prelude proceed to consider them a little more in detail, and shall extract from the Athenæum, in which publication the lectures first appeared, such portions of them as may be requisite to illustrate our observations.

The series consists of six lectures, of which the first and the last are in our eyes by much the best. They are less common-place than the others, and contain views which, if not altogether original, are exceedingly just, and cannot be too frequently insisted on. From the beginning of the first lecture we shall make an extract, partly because it contains an apology for the imperfections of the Professor's performances, of which it is right he should have the benefit.

> "The Professor began by quoting the regulation of the Royal Academy as to the Lectures on Architecture—'That the Professor shall read annually six public lectures, calculated to form the taste of the students, to instruct them in the laws and principles of composition, to point out to them the beauties and faults of celebrated productions, to fit them for an unprejudiced study of books on the art, and for a critical examination of structures.' It is understood that these lectures were to be given by a Professor in the full practice of his profession, according to the dictum of Vitruvius, 'that it is the union of the practice with the theory, that makes the sound architect;' and although he felt that it was precisely this circumstance that gave all the value in the eyes of the students to these lectures, yet it was obvious that in the midst of the distractions and bustle of professional practice, the Professor laboured under great disadvantages. It was much to be desired that the means at the disposal of the Royal Academy could enable it to extend these lectures according to the model of the French Academy, which, on Architecture alone, had established five classes, each having a separate professor,—namely, 1. Theory; 2. History; 3. Mathematics; 4. Stereotomy and Construction (in which important class two *Repetiteurs* were appointed;) 5. Perspective. Such liberal instruction secured the honour of the profession, and protected the public against empirical practice; and gave the French architects, in particular, that advantage in foreign countries, which the unassisted genius, perseverance, and enterprize of our own countrymen found it difficult to contend with. Aware of this mortifying inferiority in our public education, the students would exert themselves so much the more in their private studies to supply the deficiency, and would learn from this well-digested system the course they should pursue. This Academy had, indeed, been founded by an illustrious prince (George III.,) and great were the obligations of the arts and the public to his memory; but the means by which it existed were of its own creation, and those means were barely sufficient to fulfil its engagement, to support gratuitously the only school of art which this country possessed."

Whatever be the reason, it is at least very certain that the fine arts, with the single exception of poetry, have never thriven vigorously in this country. The want of government patronage may be one cause of their imperfect development, but is not, we think, a primary one; for the government of this country is so essentially a reflection of the public will, that its policy, for the most part becomes immediately referable to the state of public opinion. Any defective encouragement the arts may have experienced becomes, therefore, immediately chargeable upon the great body of the people; and certain it is, that of late years, at least, the productions of the chisel or the pencil have not succeeded in awakening any very deep or general sympathy. Yet this indifference is by no means attributable to any natural insensibility, on the part of the people, to the creations of the fine arts for poetry, which makes quite as great demands upon the heart and imagination as any branch of them, commands a numerous and enthusiastic auditory; and it is impossible to suppose that a nation should be deficient in a genius for the fine arts, which, in the most exalted of them all, has risen to a sublimer elevation than any other people of modern times. To us the fact appears to be, that our deficient skill in painting, sculpture, and architecture, is chiefly due to certain religious prejudices, which in spite of our better reason still cling to us, and which indispose us towards those arts as being the natural symbols of a superstitious faith. Works of art are consequently excluded from our churches, and consigned to galleries accessible only to collectors and virtuosi, and the people are deprived of the opportunity of improving their taste, or inflaming their imaginations, by the habitual contemplation of artistic productions. It is needless to say that we think this state of things is greatly to be lamented, and indeed we are of opinion that it is pregnant with more baneful consequences than are generally apprehended. The education of the people in science and useful art is steadily and rapidly proceeding, and must go on; and this continued appeal to the intellect, without any corresponding appeal to the heart is, in our eyes, calculated to event in universal scepticism. Not that we suppose religion to be unable to bear the scrutiny of science, or that truth can ever be inconsistent with itself, but that the continued devotion of the mind to scientific enquiry indisposes it to the reception of any but scientific evidence; and unless redressed by the counteracting influences, will seal up the heart against spiritual impressions. The antidote to this danger lies not in the abolition of the present means of scientific education,—which is impossible, even if it were expedient,—but in such an extension of those means to the fine arts, that the heart will also receive its proper cultivation. It is not from education that danger is to be apprehended, but from *half* education,—from education of a narrow and exclusive description, which deranges the equilibrium of our moral constitution by giving one class of capacities a disproportionate development. A scheme of education which confers an undue importance upon science finds its natural termination in scepticism; while one which gives an undue preponderance to any branch of the fine arts is as naturally productive of superstition. We do not say that such are the necessary consequences of either the one scheme or the other, but we are thoroughly assured that such are their general tendencies. It is only where the proper balance is maintained that vital and rational religion can continue to flourish; and we know of no duty more incumbent upon the ministers of our faith than the preservation of this momentous equilibrium.

We think, then, that any scheme of popular education is radically defective in which the fine arts do not occupy a distinguished place; and that, if suffered to be carried out, will be productive of impressions that, sooner or later, must end in mischief. We further think, that the popular affection for works of art must be awakened before art can flourish in this country, the public being the only source from which, in a nation such as ours, the requisite encouragement is to be derived. Nor is the task of kindling the national affection for art into a flame of enthusiasm, in our judgment, a difficult one; and, indeed, we conceive it requires very little more for its accomplishment than the removal of those puritanical restrictions which have been cast upon our institutions by a cabal of ascetic barbarians. The first step should be, to permit churches to be decorated with painting and sculptures, as in ancient times, care being taken that those works were always appropriate to the place. This would open up a field to the artist of great extent, and of the most exalted description; and the taste of the people would be improved, and their sensibilities quickened, by the contemplation of his sublimest productions. To this, indeed, it will be objected that the use of works of art as an aid to devotion savours too much of popery, and is inconsistent with the spirit of the gospel. In regard to the first point of this objection, we would ask if it is incumbent on us to reject certain instruments of emotion merely because a rival sect employs them; and if so, where the repudiation is to stop? for we may manifestly reject the aid of music, discard the sacraments, and repudiate even the Bible itself, on the selfsame principle. We may further observe, that no resources of the fine arts can be repugnant to the spirit of Christianity by which devotion is recruited, and piety brightened up; it being the purpose of those resources not to impose upon the judgment, but to address themselves immediately to the heart. Of their efficacy in this respect every person of ordinary sensibility must, from his own experience, be conscious; and there are few who are not sensible that the heart may be melted, or the spirit smitten with awe, by the creations of those 'sceptred sovereigns' whose genius shines forth in their works; and which, by imparting to our spirits a portion of its own light and heat, awakens us to a kindred state of glorified existence.

But it is not merely a wider field of which the artist would thus have the benefit; he would also have a larger circle of spectators to greet his successes with their praises; and every master spirit, instead of being the idol merely of a sect, would then be the idol of a community. Success, it is true, would be more difficult of attainment, on account of the larger number of competitors who would be attracted by the rewards which waited upon it, as well as on account of the larger field which would thus be opened up for the recruit of genius. But this very difficulty would contribute to raise art to a higher pitch of excellence; and, under these conjoined influences, we cannot doubt that this country would rise to the same eminence in the fine arts that she has long maintained in arms, commerce, and manufacture.

Such, then, are the means we should prescribe for causing the fine arts to flourish in this country; and whatever be the value of our specific, it is at least, we are persuaded, more likely to be beneficial than the establishment of academies,—a species of agency Mr. Cockerell seems to regard as being of great efficacy, but out of which we never knew much good to come. If they prevent the arts from sinking below a certain point, they as effectually prevent them from rising above it; and appear conducive to the growth of nothing but timid imitation and spiritless mediocrity. By binding upon the mind an habitual reverence for precedent, they act as discouragements to invention, and to vigorous and independent thought; and cool down the fervour of adventure to the temperature of the most orthodox routine. Wherever schools of art have flourished, the arts themselves have been found to decline; and it is, in almost every instance, from the uninstructed classes that Nature has chosen those whom she has destined for immortality. Homer came forth like the morning star of literature, before Greece had yet emerged from barbarism; and the greatest poet of our own country had but little aid from education. Occasionally, no doubt, a great spirit is called out from among the herd of academic literati, but such instances are extremely rare; and even where they arise, it will, we believe, generally be found that the vocation is in spite, and not in consequence, of that association.

We fear Mr. Cockerell must have infected us, in some degree, with his rambling propensities; for, on looking back upon what we have written, we do not find that it has any very intimate connexion with architecture, viewed as a fine art. We have, nevertheless, kept pretty nearly side by side with Mr. Cockerell all along; so that it is, in fact, he who is chargeable with our irregularities. We would now, however, say something on the more important of the points that Mr. Cockerell has touched upon, namely, the nature of architectural proportion and of the nature of sublimity and beauty.

There is no subject on which architects have more completely bewildered themselves than in that of proportion, or where a large number of them are even yet more completely at sea. The proportions of certain antique buildings have been erected into a standard of beauty, to which it is pretended all others must conform, or end in folly and deformity. Numerous diligent inquirers have set themselves to find out what, precisely, these golden proportions are; or what ratio of length to breadth perfect beauty consists in. The result of these inquiries has been only to mistify a very plain subject; we must, however, lay before our readers what Mr. Cockerell says respecting it:—

> "The αναλογια of the Greeks, delivered to us by Vitruvius—that analogy by which all the conformations of artificial bodies were derived from natural bodies, is a principle of obvious importance and utility to the architect, and should be attentively considered.
>
> "The animal kingdom furnishes clearer lights for our guidance than the vegetable, because organized nature is more constant in her proportions, and enables us always to re-establish the whole from a part; thus the hand of a Grecian statue, of the Hercules, the Apollo, or of the Venus, or a fragment of any one of the Grecian orders of architecture, enables us to restore the whole; indeed, the proportion by aliquot parts by a modulus, a principle of the Greeks, as explained by Vitruvius, (lib. i. c. 11; lib. iii. c. 1,) is still practised in India, and seems founded in organized nature.
>
> "Not so in the productions of the vegetable kingdom, fragments of which would never enable us to comprehend the whole. However indebted to this part of the creation for the graces of ornament, and various essential analogies, architecture found a less sure guide of proportion in this than in the animal kingdom: in fact, all architecture so derived is anomalous, as the Egyptian and the Gothic, in which no fixed laws of proportion have ever been applied or attempted. Columns or supports might be from five to fifty diameters in height, and are only bounded by possibility. The stunted pollard, the spreading cedar of Lebanon, the aspiring poplar, or the attenuated cane, are extremes equally at the disposal of the architect.
>
> "But that guide, which the face of nature furnished to the architect for his external forms and proportions, was wanting for the internal—as of areas, squares, courts, and open places; or of internal capacities (height as well as area); as of temples, halls, apartments, &c.; in these we must appeal to the relations of reason, purpose, and convention.
>
> "Vitruvius (lib. vi. c. 2, 3, 4, 6; lib. v. c. 1, and c. 2,) gives us the experience of the ancients on this important subject. The Greek forum, says he, was a square, but the Roman was 3 by 2, because the gladiatorial shows were exhibited there; courts should have the proportions of 5 by 3 (the favourite of the learned Palladio), sometimes 3 by 2, or sesquilateral, or the diagonal of the square will be the length. He lays down the proportions of all the apartments of the Greek and Roman house: atria, alæ, tablinium, and peristylium, triclinia, œci, exedræ et pinacothecæ. He does not, however, establish any *principle*, and his rules are wholly empirical. But the great Alberti, not content without a principle, adopts the Pythagorean doctrine of universal harmony, and agreement between sounds and numbers, namely, that what pleases the ear pleases also the eye; he lays down, therefore, his harmonic proportion, in which Blondel, Ouvrard, and others have followed. The notion of musical proportions is common, and has occupied many ingenious minds already versed in that art. Describing St. Peter's, Byron, in this feeling, observes—
>
> 'Vastness which grows, but grows to *harmonize*,
> All *musical* in its immensities.'
>
> Alberti was the first also to establish the rules of arithmetical and geometrical proportions (lib. ix. c. 3, 4, 5, 6), applied to all the varieties of areas and capacities. He is followed by Palladio in the arithmetical and geometrical rules, (lib. i. c. 23.)
>
> "It is a comfortable conclusion to the practical architect that the empirical rules of Vitruvius, the harmonic, the geometrical and arithmetical rules of Alberti and his followers, agree in the main; so that either may be adopted without material deviation from correctness; but the neglect of these rules, in which lie that hidden charm that every one must be sensible of when examining a finely proportioned room, has been common of late years, as if the principle were of no value; the zealous student, therefore, should carefully note that consent of the ancients and the most illustrious masters of the moderns, here set forth; and he will soon learn devoutly to repeat the denunciation of the Hindu Vitruvius, (Ram Raz, Asiatic Society, 1834, p. 15,) 'Wo to them who dwell in a house not built according to the proportions of symmetry.'"

There is, we fear, a good deal of this that comes very little short of nonsense. It may be allowable enough in a poet to talk of the musical harmonies of St. Peter's, as if a cathedral, to be beautiful, must be built on the law of harmonic progression; but we can find little apology for an architect who can gravely countenance so preposterous a dogma. It is impossible for a moment to imagine that there can be any direct relation between symmetry of form and harmony of sound, for this simple reason, among a thousand others, that harmony is a thing definite and immutable; whereas the proportions which are the symmetry of one thing, are the deformity of another. The proportions which give beauty to a tree, or a tiger, would be quite inapplicable to a cathedral or a woman; whereas, if those proportions had any relation to the proportion of harmony, they would all require to be equally applicable to all. Indeed, it is just as preposterous to suppose that symmetry and harmonic progression are directly related, as that the quality of beauty is measurable by the rule of three.

It will be expected, however, that we should endeavour to explain what proportion is, instead of contenting ourselves with the announcement of what it is not. This, fortunately, is not very difficult; and if we were to define it in a single word, we should say it was fitness. That structure will always be thought to have the best proportions which appears best to fulfil its intended uses; and, even in the human frame, good proportions are those which are esteemed indicative of health, vigour, and vivacity. A well-proportioned column is one which appears well calculated to bear the superincumbent weight; a well-proportioned room, one which is convenient and airy; and a well-proportioned engine, one which is neither too strong nor too weak, but which fulfils its end without useless material. Nor is there any invariable ratio in which these proportions consist; for much depends on the material employed, and something on the situation. The dimensions of a well-proportioned ship-cabin would not satisfy us in a room; nor would those of a room meet our approbation in a ship.

We have not been able to make out very clearly what Mr. Cockerell's ideas are upon the subject of beauty. He tells us, indeed, that beauty consists in proportion, and sublimity, in some measure, in disproportion; but we are not learned enough to be able to derive much light from this elucidation. If, however, it be Mr. Cockerell's doctrine that beauty and sublimity are antagonist emotions, we disagree with him; for we believe them to be essentially the same; nor can we conceive in what way ugliness, which is the antipodes of beauty, can in any way be productive of the emotion of sublimity. We explained our ideas on the subject of beauty so fully on a former occasion, that we may be excused from now going over the same ground; and, as regards the sublimity of works of art, we must content ourselves with saying that it is of two kinds—the one arising from greatness of size, and the other from greatness of conception. These varieties of the sublime are very distinguishable, and of each variety there are as many subordinate kinds as there are varieties of mental emotion. Thus there are some kinds of sublimity which fill the soul with an inward glorying and exultation, and others which speak in accents of humility and awe; and the impressions of the same object will be different on different individuals, and even on the same individual at different times.

In designing buildings of a large size, it is very necessary that some resource should be employed to make the spectator sensible of their dimensions, otherwise much of their effect will be thrown away: and this may be achieved either by forming a contrast with surrounding buildings of a greatly smaller size, or by so extending some one dimension that the attention of the spectator will be particularly directed to it. Mr. Cockerell makes many interesting and apposite observations upon this head, of which it is right our readers should have the advantage.

> " If we stand under an arch of London Bridge, the vaulted soffite, so vast and extended, sustained from such distant abutments, produces a kind of sublime; no doubt aided by its comparative lowness. The Pantheon is inscribed in a cube, its height equal to its diameter; no one standing under its prodigious cupola has ever denied its sublimity. But when that same Pantheon is raised into the air (in equal dimension) at St. Peter's, it may have become beautiful, but has lost its quality of sublime.
>
> " As the dome of the Pantheon is raised at St. Peter's into a proportionate height, at the expense of its sublime, so the nave (nearly twice as wide as that of St. Paul's cathedral), also raised proportionately, loses all effect of magnitude; and the common and universal observation is, that, as respects this important effect, the architect has laboured in vain; and the work stands self-condemned.
>
> " Some years ago a French giant, upwards of nine feet high, exhibited himself in London; but so just were his proportions, that no one would give credit to his dimension, till they stood beside him; he was therefore accounted a kind of fraud, and the exhibition failed. But had he been disproportioned, his head small, his shoulders high, and his members excessive, he might have succeeded, even had he been a foot shorter. Had the nave of St. Peter's, 77 feet wide, been 90 feet high only, instead of 145; or if we were to suppose a stage raised mid-height, and place ourselves upon it, we should be sensible of its vast latitude, and the effect of magnitude would have been produced as under a bridge. The Barrière de l'Etoile, from the same reasons, though as large as the front of Notre Dame—the arch itself 48 by 95, equal to the height of the nave, but of ordinary proportions and great simplicity of parts and members—loses its effect: the *arc monstre* is glorious to the *grande armée*, but not to the arts of their day; and it is infinitely less artificial in its combination than the arches of St. Martin and St. Antoine, designed by the accomplished Blondel.
>
> " If, then, the architect can obtain latitude, he should seek to carry out its effect by quadrate and comparatively low proportions; but if he adds altitude to his latitude, he loses his expense and pains, and he may find too late that half his dimension might have attained the same effect: since *proportionate magnitude* defeats itself.
>
> " But as extreme latitude gives the sublime, so does its opposite extreme of altitude. In Cologne and Beauvais, the naves of which are three and a half diameters in height, though scarcely more than half the actual width of St. Peter's nave—limited, therefore, in their dimension to the usual cathedral width, yet nearly double the usual proportion—the sublime is completely attained; and disproportion again appears to be the efficient cause.
>
> " But the optical consideration of the visual angle in which these proportions present themselves is exceedingly important. Thus to the spectator of the dome of the Pantheon, the visual angle is 95°, while the same dome raised into the air at St. Peter's is only 30°. In the nave of St. Peter's, the visual angle is 48°, that of St. Paul's cathedral is 37°, while the vault of Cologne is only 22°. Since, then, the effect of magnitude is measured by the number of degrees in the visual angle, the architect will advert to this consideration as of extreme interest.
>
> " We come, then, to the important conclusion that the sublime and the beautiful are to be found in the proper adjustment of proportions, rather than in dimensions; and we may infer, that no increase of scale to the beautiful will ever make it the sublime.
>
> " But the sublime is of rare occurrence: the use, however, to which these reflections may be turned by the practical architect, under limited means, is remarkably illustrated in the Casino at Chiswick, where the very circumscribed area of the rooms is compensated by their extraordinary height; and the accomplished Lord Burlington has given a nobility to very small apartments which no one could believe on seeing the plan alone, without visiting that elegant work.
>
> " Magnitude is the great object and result of design, and this quality is only to be attained by the fine adjustment of relative proportions in magnitude and order. Architecture (says Aristotle) consists in magnitude and order, (*τὸ γὰρ καλὸν ἐν μεγέθει καὶ τάξει ἐστι.*) The works of man, compared with those of Nature, display our insignificance. The Pyramids, seen in the clear sky of Egypt, or St. Peter's at Rome, are proverbially disappointing to the first gaze of the beholder: it is only after he has instituted comparisons and admeasurements that he becomes sensible of the greatness of these human efforts,—and his memory will supply him with many instances in which objects of very inferior dimensions have surpassed them in impression of magnitude upon his mind. It is plain, therefore, that art alone can produce the full effect of magnitude, and to this the architect should direct all his skill: the ancients will be found consummate masters in this as well as in every other department of our art. It is, indeed, a fine art which enables the accomplished artist to raise ideas of magnitude and grandeur of composition on a piece of paper no bigger than your hand; while a less able one shall cover a vast canvass without executing any comparable notions. Worthy of all inquiry and solicitude is such an art, for it is the whole art of design and proportion. Pliny cites a statue of Hercules, so small that it might be lifted by the hand, which, however, conveyed more grandeur, magnitude, and strength, to the mind of the observer, than a colossus would have done. How great must have been the science of the master! and if, with such small means, he could affect the mind with these impressions, how great the economy of cost and material to the employer!"

We cannot say that we concur in all that we have here extracted. In particular, we would record our dissent from the doctrine that no increase of scale in the beautiful will ever make the sublime; for to us nothing is more obvious than that there is one variety of the sublime which arises from magnitude merely. We shall not waste our own or our readers' time in illustrating so self-evident a truth, and would merely, in conclusion, beg leave to express our incredulity that a very small statue could ever appear as large as a colossus, except, indeed, by the aid of some cunning microscope. We willingly surrender all such tales to the faith of Pliny and Mr. Cockerell.

But we must hasten to a close: and we shall conclude our extracts with one or two passages, which are so superior to any thing we have hitherto met, that they scarcely appear the work of the same person. The following is very good, but is not the best of the specimens.

> " In examining architectural works, the student should bear in mind an important rule of criticism, which is, to account in precise terms, for the motives of approbation or dislike which he might experience. By applying a just expression on all occasions, he would soon cease to take one thing for another—the beautiful for the sublime—quantity for quality—cost for magnificence—and either of these for proportion or fitness—ornament for art. He would learn to apply characteristic terms to every gradation, quality, and style; and so, by degrees, he would form a just and discriminating taste.
>
> " In an art and science essentially referrible to association, this discrimination was peculiarly necessary: the emotions arising from sight, like those from music, would often be found irrespective of the intrinsic merit of the performance, as loyalty in hearing 'God Save the Queen;' union and patriotism in the 'Marsellaise.' Often patriotic, historical, and romantic associations will blind us to forms and styles, otherwise both unfit and unworthy our age; often quantity, extent, and quality of material would impose that approbation which ought only to be accorded to elegant and just proportions; elaboration would often usurp the praise which was due only to a well-ordered work.
>
> To hide by ornament the want of art
>
> should not deceive the experienced critic; and the painter 'who would make his Venus *fine*, not knowing how to make her *beautiful*,' would be ranked as he deserved. The discernment of merits rather than defects will be found more difficult, and much more profitable, because those we shall appropriate, while the latter are only to be rejected. Such a habit will exercise the better qualities of the mind, and lead to originality. The works of men who have long enjoyed reputation should be the peculiar objects of our critical examination; they will seldom be found frauds; the inquiry will commonly justify their fame, and, like the conversations of original inventors, they will reveal secrets which can else hardly be discovered."

The following is full of the eloquence of truth and sincerity.

> " There were two errors which the art was expressly liable to: the first was the presumption of absolute novelty; the second, the indolent and servile imitation of former styles. The latter was the peculiar vice of these times throughout all the civilized countries of Europe. Grecian, Gothic, Byzantine, Italian, Revival, French, were indifferently employed. There was no attempt at a style which should express to future ages the century in which we live; and posterity will be at a loss to recognize in the buildings of our day, that character which a country great and glorious at the present period, the bulwark of civilization, the arbiter of the world, and the great exemplar of political government, morals, and useful science, should impress upon its architectural productions. Shall it be said that this great

people, original and free in other respects, adapting and expanding itself in an unexampled manner to times and improvements, was stationary, or rather retrograde, in the arts alone?—that though science, and capital, and mechanical skill, were daily furnishing new engines for our arts, with prodigality, that our invention alone, in these walks of genius, was at a stand?—that our skill as artists was the only deficiency in the march of our age?—that they crudely adapted the models of ancient Greece to modern London; the sunny palaces of Italy to the foggy atmosphere of England; the niched and canopied architecture of a religion, peopled with images of saints and martyrs, sibyls, angels, and holy men, to a Protestant religion, which, admitting none of these, must leave the niches and the canopies *tenantless*; like well-gilt frames adorning an apartment, the *pictures* being omitted: the pride and pomp of heraldry, armorial shields, and crests, to an age in which chivalry was exploded, and quarterings had dwindled to insignificance? What should we say of Harry the Sixth, if, instead of that admirable and most original chapel of King's College, at Cambridge, he had limited his artists to the style of the Conqueror, or any other imitation; or if Henry the Seventh had concluded on carrying on the style of the cathedral of Henry the Third, and so on: saving all further trouble of invention and criticism, should we not contemn their poverty of spirit and negation of mind? Would not the historian, the artist, and the tasteful observer, have to deplore the absence of that internal evidence and hieroglyphic character of the times which adds such a relish to the architectural remains of our fair and beloved country?"

In the following remarks, too, we perfectly concur; and we think they are perfectly unanswerable.

"Restoration, indeed, is a different consideration, and the happiest result of this taste is, that we reinstate, for centuries to come, these venerable antiquities to which we have so many reasons of attachment. The restoration of the Palace at Westminster may find under this consideration a sufficient apology. But for works altogether new, such a system of imitation is not reconcilable with our pretensions to genius and enlightenment; and it does appear that there is in it a vice of mind, or of industry, for which posterity will visit us. Such an indifference as to choice of styles indicates, in fact, an absence of culture and perception of the really fit, and beautiful, and great,—a state of mind which, in religion, politics, or morals, would be accounted fatal to improvement, and the sure forerunner of every heresy. D'Agencourt attributes to this spirit of imitation, under the emperor Hadrian, the decline of taste in Rome. The learned in Paris deplore it, not only under this apprehension, but as the imposition of anachronisms on posterity, and as the falsification of the pages of history, in its most interesting and characteristic traits. 'Have we not,' as says Isaiah, 'a lie in our right hand?'

"It is very important that the merits of that question should be debated in a candid spirit, and that the true grounds of a style should be investigated by the rules of sound criticism; as, how far architecture has ever been and should be the picture in which all the discoveries of mechanics, of materials, and of industry, are to be exhibited and recorded; and whether the successive changes of style have not been chiefly owing to the progressive discoveries and improvements on workmanship, materials, and convenience,—how far the combinations of this art are capable of displaying the intellectual character of an age and people, and what should be the just bounds and limits of association, authority, and imitation."

Such, then, are the lectures of Professor Cockerell; and, in spite of their faults, it is not difficult for us to believe that their author possesses a greater share of genius than usually falls to the share of the members of his fraternity. It is in the metaphysics of the art that he is chiefly deficient; and certainly his expositions respecting beauty and sublimity are not merely very imperfect, but occasionally very fallacious. But he ceases to be in the wrong as soon as he throws philosophy to the winds, and trusts to his own sensibilities and instincts, which, if they sometimes give a wrong reason, generally give a right result.

ART. II.—TABLE OF DIMENSIONS OF THE PARTS OF LOCOMOTIVE ENGINES.

NAME OF RAILWAY.	Belgium.		Bordeaux and La Teste.		North Midland Counties.		Northern and Eastern Counties.		Great Western.		Hartlepool.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Width of Railway between rails . .	4	8½	4	8½	4	8½	5	0	7	0	4	8½
Diameter of boiler (inside) . .	3	4¾	3	1⅜	3	7¼	3	7¼	3	11¼	3	5¼
Length of ditto	8	2	8	9	8	6	8	0	8	6	8	6
Thickness of plates . . .	0	0⅜	0	0$\frac{5}{16}$	0	0⅜	0	0⅜	0	0⅜	0	0⅜
Length of outside fire-box . . .	3	8¾	3	4½	4	0	4	0¼	4	6	3	7
Breadth of ditto . . .	4	0	3	9½	4	0	4	0¼	4	8	4	1
Depth below boiler . . .	2	0	1	8	2	2	2	2	2	3	2	0½
Height above ditto . . .	0	4¼	not ascertained		2	7	2	7	2	1	0	4¼
Thickness of plates . . .	0	0⅜	0	0⅜	0	0⅜	0	0⅜	0	0⅜	0	0⅜
Length of *inside* fire-box . .	3	0¼	2	8	3	3⅝	3	3¾	3	8⅛	2	10½
Breadth of ditto	3	4½	3	2	3	4⅝	3	4¾	3	10⅞	3	5¼
Thickness of copper plates . .	0	0⅜	0	0⅜	0	0⅜	0	0⅜	0	0½	0	0½
Extra thickness of ditto for insertion of tubes .	0	0⅜	0	0⅜	0	0⅜	0	0⅜	0	0⅜	0	0¼
From bottom of fire-box to top of fire-bars .	0	8	..		0	9	..		0	9	0	8
From top of fire-bars to crown of fire-box .	3	4½	..		3	7½	..		..		3	5
Area of fire-grate in sup. feet . .	10	2½	..		11	2	11	3	12	10	9	10½
Length of smoke-box (inside) . .	1	11¾	1	11⅞	2	1	2	1	2	2½	2	1
Breadth of ditto (outside) . .	3	11½	4	1	4	2	4	2¾	5	2½	4	2
Thickness of tube plate . . .	0	0½	0	0½	0	0½	0	0½	0	0⅝	0	0½
Ditto of side plates . . .	0	0¼	0	0¼	0	0¼	0	0¼	0	0¼	0	0¼
Diameter of chimney (inside) . .	1	0¾	1	0	1	2	1	2	1	4	1	2
Height of top of ditto from rails . .	....		13	0	14	0	13	6	14	10	13	6
Number of brass tubes . . .	86		94		123		121		131		105	
Exterior of diameter of ditto . .	0	2¼	0	2	115 at 2 8 at 1⅝		0	2	127 at 2 and 4 at 1⅝		0	2
Thickness of tubes.—Wire gauge . .	No. 14		No. 14		No. 14		No. 14		No. 12		No. 14	
Distance from centre to centre of tubes .	0	3	0	2¾	0	2¾	0	2¾	0	2⅞	0	2¾
Diameter of steam dome (inside) . .	1	5	..		..		..		..		1	7
Height of ditto . . .	2	7⅝	..		..		..		..		2	7⅝
Diameter of safety valves . . .	2½ and 3		3¼ and 3¼		4 and 4		4 and 4		3¼ and 3¼		2½ and 3	
Diameter of inside copper steam-pipe .	0	5	0	5	0	6¼	0	6¼	0	6½	0	6¼
Thickness of ditto.—Wire gauge . .	No. 10		No. 10		..		..		No. 10		No. 10	
Diameter of branch steam pipes (inside) .	0	3½	0	3½	0	4⅛	0	4⅛	0	4½	0	4⅛
Diameter of top of blast pipe (inside) . .	0	2½	0	2½	0	3	0	3	0	3⅝	0	3
Diameter of cylinders . . .	1	0½	1	0	1	2	1	2	1	3	1	2
Length of stroke	1	6	1	6	1	6	1	6	1	6	1	6
Distance of centres of cylinders . .	2	5	2	5	2	5	2	5	3	0	2	5
Size of steam ports . . .	11 × 1		9½ × 1		11 × 1¼		11 × 1¼		11 × 1¼		11 × 1¼	
Ditto of eduction ports . . .	11 × 2		9½ × 2		11 × 2½		11 × 2½		11 × 2⅝		11 × 2½	
Breadth of bridge between ports . .	0	0¾	0	0¾	0	0⅝	0	0⅝	0	0⅝	0	0⅝
Lead of slide valves . . .	0	0$\frac{3}{16}$	0	0¼	0	0$\frac{3}{16}$	0	0$\frac{3}{16}$	..		0	0$\frac{3}{16}$
Cover of ditto	0	0$\frac{5}{16}$	0	0⅜	0	0½	0	0½	0	0¾	0	0$\frac{5}{16}$
Distance from centre of cylinder to centre of steam chest	0	11	..		1	0⅛	1	0⅛	1	2	1	0⅛

NAME OF RAILWAY.	Belgium.		Bordeaux and La Teste.		North Midland Counties.		Northern and Eastern Counties.		Great Western.		Hartlepool.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Thickness of piston		3⅜		3⅜		4¼		4¼		4		4¼
Diameter of piston rod		2		2		2		2		2¼		2
Ditto of valve spindle		0⅞		1		1		1		1⅛		1
Ditto of pump ram		1⅞		2		2		2		2¼		2
Length of pump lever		6¾	None			6¾		6¾	None			6 5/16
Diameter of ball valves		2		2 7/16		2 7/16		2 7/16		2½		2 7/16
Ditto of union and suction pipes (inside)		1¾		1¾		1¾		1¾		2¼		1¾
Diameter of driving wheels	5	6	6	0	5	0	6	0	7	0	4	6
Tyres of ditto in centre of tread	..		6 ×	1¾	7 ×	1¾	7 ×	1¾	5½ ×	2	5½ ×	1⅝
Diameter of leading wheels	3	9	4	0	5	0	4	0⅝	4	0	4	6
Tyres of ditto	..		5½ ×	1⅝	6 ×	1¾	6 ×	0	5½ ×	2	5½ ×	1⅝
Diameter of trailing wheels	3	9	4	0	3	6	4	0	4	0	None	
Tyres of ditto	..		5½ ×	1⅝	6 ×	1⅝	6 ×	1⅝	5½ ×	2		
Diameter of plain part of cranked axle		4¾		5		5½		5½		6½		5⅞
Ditto of inside bearings		5		5		5¾		5¾		6½		5⅜
Length of ditto	3¼ and	3		3	3¼ and	3	3½ and	3		4		3
Radius of ditto	3 and	2⅜		2⅜	2 15/16 ×	2 9/16	2 9/16 and	2 15/16		5½		2 9/16
Diameter of crank pins		5		5		5¾		5¾		6½		5⅜
Length of ditto		3		3		3		3		4		3
Radius of ditto		2⅜		2⅜		2 9/16		2 9/16		5½		2 9/16
Diameter of outside bearings		3¼		3¼		3¾		3¾		4		3½
Length of ditto		5½		5½		5½		5½		6¾		5½
Diameter of bosses on axle for eccentrics	6⅝ and	4¾	5 and	5	7 and	5½	7 ×	5½	7¼ and	6½	7 ×	5⅞
Ditto of ditto for driving wheels		6⅛		6⅛		6½		6½		7¼		6½
Length of ditto for ditto		7½		7⅜		8⅛		7⅞	..			7¼
Diameter of axle for leading wheels		3¾		4		5		4½	6¼ and	4¾		4¾
Ditto of bearings for ditto		3⅛		3⅛		3¾		3¾		3½		3½
Length of ditto for ditto		5½		5½		5½		5½		6¼		5½
Diameter of boss for wheels		4½		5		6½		5½		5¾		5½
Length of boss for ditto		6¾		7		8⅛		7⅝		8		
Diameter of axle for trailing wheels		3¾		4		4½		4½	6¼ ×	4½		
Ditto of bearings		3⅛		3⅛		3¾		3¾		3½		
Length of bearings		5½		5½		5½		5½		6¼		
Diameter of boss for wheels		4½		5		5		5½		5¾		
Length of boss		6¾		7		8		7⅝		8		
Diameter of boss on axle for outside cranks	None		None			4¾	..		None			4¼
Length of ditto	..		..			3⅜	..		..			3⅞
Length of outside cranks from centre to centre	None		None		1	1½	..		None		1	1½
Diameter of plain pin on ditto	..		..			1¾	..		..			1¾
Length of plain pin	..		..			2	..		None			2
Diameter of ball pin	..		..			2 11/16	..		..			2⅝
Outside frame (extreme breadth)	6	4	6	4	6	5	6	8½	8	9¼	6	3¾
Length of ditto	18	3	18	2½	18	3	18	2½	20	4	18	3
Depth of frame sides		7		7		7¼		7¼		8		7¼
Thickness of ditto		4		4		4		4		4¼		4
Thickness of side plates		0⅜		0⅜		0⅜		0⅜		0⅜		0⅜
Ditto of horn plates		0⅜		0⅜		0⅜		0⅜		0½		0½
Length of driving-wheel springs	2	8	..		2	9	2	9	2	6		
Breadth of ditto		3⅞	..			3⅞		3⅝		3¼		
Number of plates	2 at 12 at	0⅜ 0¼	.. ..		1 at 12 at	0⅜ 0 5/16	1 at 14 at	0⅜ 0 15/16	2 at 10 at	0⅜ 0 5/16		
Length of leading wheel springs	Ellip. 2	2	..		2	9	Ellip. 2	0	2	3		
Breadth of ditto		3	..			4		3		3¼		
Number of plates	2 at 11 at	0 5/16 0¼	.. ..		1 at 14 at	0⅜ 0 5/16	1 at 11 at	0⅜ 0 5/16	2 at 10 at	0⅜ 0 5/16		
Length of trailing-wheel springs	Ellip. 2	2	..		Ellip. 2	0	Ellip. 2	0	2	3		
Breadth of ditto		3	..			3		3		3¼		
Number of plates	2 at 8 at	0 5/16 0¼	.. ..		1 at 6 at	0⅜ 0 5/16	1 at 6 at	0⅜ 5 5/16	2 at 8 at	0⅜ 0 5/16		
Diameter of eccentrics	0⅝ and	12½		10⅞	1	1	1	1	1	1¾	12½ ×	11⅞
Throw of ditto		1¾		1⅛		1 13/16		1 13/16		1¾		1 9/16
Breadth of ditto (brass hoops)		1¾		1¾		2¼		2¼	Iron .	1¾		1¾
Diameter of valve gear shafts		2⅛		2⅛		2⅛		2⅛		2¼		2⅛
Diameter of journals to ditto		1¾		1¾		1¾		1¾		2		1⅞
Length of journal		2½		2½		2½		2½		2¾		2¾
Length of slide levers		5		5		6		6		6½		6
Length of fork-end levers		6½	5 and	4 1/16		6		6		5¾		6
Diameter of ferrules		1⅝		1⅞		1⅞		1⅞		1⅞		2
Length of lifting levers		10	1	0	1	0	1	0	1	3	1	0
Length of reversing levers	12 and	10	1	0	12 and	10	12 and	10	1	3	1	0
Distance between motion bars		8½		7⅞		7		7¾	1	0¾		
Diameter of ball on cross-head spindle		3		3		3⅛		3⅛		3⅜		3⅛
Diameter of connecting rods in middle	..			2½		2⅝		2⅝		2¾		2⅝
Inside horn bars	4 ×	1	3¾ ×	1⅛	3½ ×	1¾	3¼ ×	1¾	4½ ×	1½	3¼ ×	1½
Distance from centre of crank axle to fire-box	1	6	1	6	1	6	1	6	1	5⅜	1	3
Distance from centre of crank axle to centre of leading axle	5	6	6	2	5	6	5	7	6	7	5	10½
Distance from centre of crank axle to centre of trailing axle	5	6	5	3½	5	9	5	9½	6	7	None	

Observations.

In the construction of the boilers for these engines, the cylindrical parts of each are fixed to the smoke and fire-boxes, by 2½in. angle irons round the upper, and 3in. angle irons round the lower half of the boiler, firmly riveted with ¾ of an inch rivets. The tops of the outside fire-boxes of the engines for the North Midland, Northern and Eastern Counties, and the Great Western Railways, are worked into a dome-shaped figure, by which means the advantage is obtained of placing the regulator, with its appendages, immediately over the inside fire-box. The man-hole being also placed in this dome, admits of a free access to the interior of the boiler.

The outside fire-boxes for the engines of the Belgium Railways, having low semicircular tops; the steam domes are fixed on the cylindrical part of the boiler, and the regulators fixed to the tube-plate of the smoke-box. The inside fire-boxes are formed of copper plates of the dimensions shown, that portion of the tube-plate, necessary for the insertion of the tubes, being increased in thickness in order to increase its stability, as well as to assist in the more perfect securing of the tubes. The opening, in the front plate for the smoke-box doors are in all respects sufficiently large to admit of free working room, for the removal and reinstatement of the copper tubes of the boiler, as occasion may require.

In the inside fire-boxes of the engines for the Great Western Railway, there are low hollow partitions, forming a clear water space of 4 inches across the box; in the sides of this box to which the partition is riveted, apertures, eight by four inches, are cut so as to allow of the free escape of steam from this division.

The cylinders in the whole of the engines here enumerated are fixed in the lower part of the cavity of the smoke-box, and firmly bolted to the front and back plates; these plates being cut to receive the same.

The pipes from the eduction ports, (excepting in the engines for the Great Western Railway,) are cast on the body of the cylinders, and extending across towards the middle, and uniting with its corresponding pipe, is strongly bolted thereto; on the upper surfaces of these pipes, flanches are cast with a horizontal plane, upon which the blast pipes are fixed.

The blast pipe of copper, of a conical or pyramidal shape, formed with flanches at the bottom, is placed immediately over the junction of the pipes from the eduction ports, and firmly bolted thereto.

The pumps are fixed either directly or indirectly to the outer bars of the inside frame work, as the shape and position of the parts may require; the rams of the engines for the Great Western Railway are worked immediately from the spindle of the cross-head; those of the North Midland, and the Belgium engines, by an arm or lever attached to the piston rod. The whole of the valve-gear, as well as the carriages for the cross-head guide-bars, are supported in their position by strong iron framework, technically called horn bars. These bars extend from the back plate of the smoke-box to the front plate of the outside fire-box; and bolted to lugs fixed thereon to receive the ends of the bars. These bars also serve the purpose of staying the crank axle by means of horns, which are worked on the bars, and in which the bearings are fixed. The inner horn bars of the engines for the North Midland, the Belgium, and the North Eastern Railways, extend in a parallel direction, from the smoke-box to the extreme length of the guide-bars; and from thence obliquely in a Y shaped form, uniting with each other, and forming, with the two outside horn bars, a third stay to the crank axle.

The construction of the valve gear of the engine for the Bordeaux and La Teste Railway, differs widely in its details from the rest of the engines here noted. The eccentric bosses are placed close to each other, in the middle of the driving-wheel axle, the end of each eccentric rod being furnished with a pin on which the ferrules are placed, instead of forked ends, as has been hitherto generally adopted.

On the shaft which gives motion to the valve lever is fixed a double lever, with forked ends; in the hollow of each fork a socket is formed for the reception of the pin and ferrule on the end of the eccentric rod; and of such depth as to allow the lever to have a throw, variable from 4$\frac{1}{16}$ to 5 inches.

Each of these fork-ended levers are placed in a vertical position with each other; but acting in opposite directions upon the inner end of the valve shaft.

The eccentric rod ends are connected with a lever on the reversing shaft, by lifting and lowering links, which not only admit of the eccentrics being thrown in or out of gear; but also allow of a greater or less degree of travel to the slide-valve, by increasing or diminishing the throw of the fork-ended lever.

The peculiar advantage of the plan thus adopted is obvious from the economy in the saving of steam; the travel of the slide being regulated so as to admit of no more steam into the cylinder than what is necessary to propel the engine at the velocity required.

Art. III.—THEORY AND PRACTICE OF SHIP-BUILDING.

Treatise on the Theory and Practice of Naval Architecture; being the article 'Ship-building,' in the seventh edition of the Encyclopædia Britannica. By Augustin F. B. Creuze. Edinburgh: Adam and Charles Black. 1841. (Second notice.)

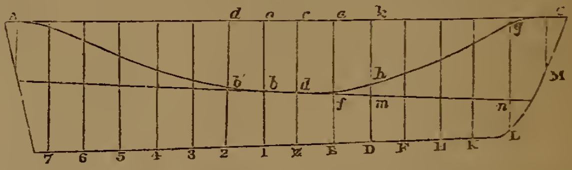
Designing Ships.—To design the body of a ship by a strictly scientific method is a work of much labour and difficulty, and is very seldom done. Most ship-builders are in possession of some mechanical method of arriving at the desired end; and although none of these methods, perhaps, are strictly correct, or deserve to be accepted as giving a perfectly true result, yet they are probably refined enough for most ordinary purposes, and are of much convenience in practice. The ship-builder, however, should always bear in mind, that an acquaintance with any empirical method of designing a ship does not constitute ship-building science or proficiency; and, indeed, it is evident that any one may acquire information of this quality in a very brief time, and be little better for the acquisition. So far as the adoption of a mere mechanical mode of designing a ship facilitates or accelerates the work, it is to be regarded as a useful aid; but whenever any such method becomes a mere juggle for producing a ship, without consideration of the many circumstances which should be kept in view, it is to be reprehended as derogatory to the art, and as an effectual barrier to improvement.

It would be impossible, within the limits to which we are restricted, to give any intelligible account of the various mechanical methods of delineating ships, that have been adopted in practice. The little we can afford to say on the subject we shall devote to an explanation of Chapman's parabolic system of construction, which has more science in it than any of the others, and appears more susceptible of an extensive application. Indeed this method is a most valuable contribution to naval architecture: it is applicable to all sorts of ships, whether sharp or otherwise, as it only requires that the relative areas of the several cross-sections shall decrease from the middle towards each end in a certain relation, which may be infinitely varied.

In the development of this system, the first thing was to discover whether, in a well-formed ship, the several transverse sections followed any and what law. To ascertain this, Chapman calculated the areas of the sections of several ships; and in order to make the numbers more convenient, he divided these areas by the breadth of the midship section; then, at their respective stations on the drawing, setting off from the water-line, distances equal to the quotients, he traced a curve representing the areas. This curve he called the curve of sections. He then endeavoured to find the equation to the curve, or rather that of another curve which would coincide with this for the greatest length; and he found, that if the power and parameter of a parabola were so determined as to allow that curve to pass through three given points of the curve of sections, the two curves would nearly coincide. In the fore-body the three points were taken; one forward, one at the midship section, and one midway between. In the after-body the points were similarly situated. In some ships the exponent to the curve was higher in the after-body than in the fore-body, in some it was the same for both. It was also found that there were ships in which the curve of sections almost exactly agreed with the parabola, and these ships invariably bore excellent characters. Chapman consequently concluded, that if the areas of the several sections of a ship were made to follow the law of the abscissas of a parabola, a vessel possessing good sailing qualities might be formed, and the process of construction much simplified.

Suppose a ship is found to answer well at some given water-line, AC (fig. 1). Let the areas of the transverse vertical sections be divided by some constant quantity, as, for instance, the breadth; and suppose the distances *ab*, *cd*, &c. equal to the quotients, to be set off on the respective sections from the water-line; then a curve drawn through the points *b*, *d*, &c. will be the curve of sections. It will be found to be convex to the water-line at the extremities.

Fig. 1.



The order of the parabola which coincides for the greatest distance with this line may easily be found.

Let the general equation to the parabola be expressed by $y^n = ax$; then it is always possible to determine n and a, so that the parabola shall pass through two points besides the vertex. Any two points between b and C may be taken, but it is evident that the farther apart the three points are taken, the longer will the parabola coincide with the line of sections. Of course, neither point may be in the convex part of the line of sections. It will be found that the point g at the foremost frame, and h in the middle, between g and b, are the points which should be taken.

Draw a tangent to the curve at the point b, which will be parallel to the water-line; then mh and ng are abscissas, bm and bn ordinates to a parallel passing through b, h, and g; put $mh = x'$, $ng = x''$, $bm = y'$, and $bn = y''$; then, substituting these values in the equation to the parabola, we have

$$y'^n = ax', \text{ and } y''^n = ax'',$$
$$\text{or } n \log. y' = \log. a + \log. x', \text{ and}$$
$$n \log. y'' = \log. a + \log. x'';$$

$$\text{hence } n = \frac{\log. x' - \log. x''}{\log. y' - \log. y''}$$

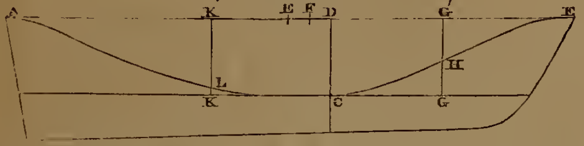
$$a = \frac{y'^n}{x'},$$

$$\text{and log. } a = \frac{\text{log. } x' \cdot \text{log. } y'' - \text{log. } x'' \cdot \text{log. } y'}{\text{log. } y' - \text{log. } y''}.$$

We have now the values of n and x, and by calculating several other abscissas, we can trace the parabolic curve. The same operation, applied to the after-body, will give the exponent and parameter of the parabola, which is the most similar to the curve of sections in that body.

From this reasoning, it appears that ships may be constructed to coincide exactly with the parabolic line, without deviating from the forms which experience has proved to be the most conducive to giving ships good qualities. Chapman stated that this would most probably be superior to the old system, and the result has confirmed his statement; for ships of the line, frigates, and merchantmen have been constructed after it, all of which have been very fine vessels.

Fig. 2.



From the manner in which the curve of sections is formed, it follows that its area, multiplied by the breadth, is equal to the displacement, and that the centre of gravity of the area is in the same transverse section as the centre of gravity of the body; but the area of this curve, supposing it to be a parabola of a certain power, is a known part of the rectangle formed by the greatest ordinate and the abscissa; hence, by making the areas of the sections decrease in the ratio of the abscissas in the parabola, we obtain certain equations between the quantities. To find these equations, suppose the parabolic line, now also representing the line of sections, to be ACB (fig. 2), cutting the water-line at some distance from both rabbets; let C be the place of the midship section, and DC the greatest abscissa. Put AB $= l$ and DC $= d$, let the exponent of the parabola before and abaft $= n$, and the displacement $=$ D; then the area of the parabolic line BDACB $= \frac{n}{n+1} \cdot l \cdot d$, and the displacement $\frac{n}{n+1} \, l \cdot d \cdot \text{B}$ (B representing the breadth); but $d\text{B}$ = area of the midship section; hence $\frac{n}{n+1} \cdot l \cdot (\textit{area of midship section}) = \text{D} \ldots (1)$.

Let E be the middle point of the water-line AB, which we may call the construction water-line, F the place of the centre of gravity in point of length; let ED, the distance the midship section is before the middle of the water-line, $= k$, and EF, the distance the centre of gravity is before the middle, $= a$. We will now determine the place of the midship section in reference to the situation of the centre of gravity F.

As BCD represents the displacement of the fore-body, and CDA that of the after-body, the moments of these two parts will give the common moment.

The centre of gravity of the parabolic area is at a distance from the abscissa DC $= \frac{n+1}{2n+4} \times$ the ordinate DB,

and for the parabolic area DCA it $= \frac{n+1}{2n+4}$ DA.

The moment of DCB from the point E $= \left(k + \frac{n+1}{2n+4} \cdot \text{DB}\right) \cdot \text{DCB}$,

and the moment of DCA from the same point $= \left(\frac{n+1}{2n+4} \cdot \text{DA} - k\right) \text{DCA}$.

But the areas DCB and DCA are proportional to DB and DA, and the sum of the above moments $=$ EF $\cdot$ BCA, or $a \cdot l$, l representing the area; hence

$$al = \left(k + \frac{n+1}{2n+4} \text{DB}\right) \text{DB} - \left(\frac{n+1}{2n+4} \cdot \text{DA} - k\right) \text{DA}$$

$$= -\frac{n+1}{2n+4} (\text{DA}^2 - \text{DB}^2) + k(\text{DB} + \text{DA})$$

$$= (\text{DA} + \text{DB}) \cdot \left(-\frac{n+1}{2n+4} \cdot (\text{DA} - \text{DB}) + k\right);$$

but DA $-$ DB $= 2k$, and DA $+$ DB $= l$; hence $al = lk \cdot \left(1 - \frac{n+1}{n+2}\right)$,

$$a = k \cdot \frac{1}{n+2}; \text{ or } k = a \cdot (n+2) \ldots\ldots\ldots (2).$$

That is, if the midship section DC is placed at such a distance k from the middle point of the construction water-line, the centre of gravity will be in the point F assigned to it.

These two equations (1 and 2) form the principal foundation of the parabolic method of construction. In the first equation, any quantity may be known by assigning values to the others; and in the second, by fixing a value for the distance of the centre of gravity before the middle, the place of the midship section will be known. Then, having by the first equation found the exponent of the parabola, any abscissa GH or KL may be calculated. Suppose, for instance, GH to be required; then in the first assigned equation $y^n = ax$, n is known; also y and x are known for a certain point B, through which the parabola passes; the value of y for this point is DB, and of x is DC. This gives

$$a = \frac{\text{DB}^n}{\text{DC}} = (\text{by cutting DB} = f) \frac{f^n}{d} \ldots . (3).$$

Now GH is easily determined in the above equation, by assigning a value to CG; if CG, or any other ordinate, is expressed by y', the corresponding abscissa GH $= x''$ is determined by the equation

$$x' = \frac{y'^n}{a} \ldots\ldots (4).$$

This equation is sufficient for calculating the areas of all the sections for the fore-body; and for those of the after-body we have the equation (3), in which, by substituting f for DA, we get the value of the parameter a' of the parabola of the after-body; and substituting this value for a in equation (4), and giving to y' any value CK, a corresponding abscissa LK is obtained. And in the same manner, as many may be found as may be thought proper. It is evident that GH and LK must be subtracted from the largest ordinate DC, to give G′H and K′L, which represent the areas of the corresponding sections.

This method of first calculating the abscissas, and then subtracting them, may appear indirect, as the true lines G′H and K′L could have been obtained at once by transforming the equation of the parabolic line to another, beginning at the point D; but it would then have lost its simplicity, and the calculations would not have been easier than by this method. One thing may, however, be done, which is to substitute the area of the midship section, instead of its quotient by the breadth, by which the whole areas of the other sections will be obtained, instead of the lines which represent them.

The principles of the parabolic method being now explained, it will be easily seen how very useful its application is to the comparison of all ships, whether they were constructed with or without reference to it.

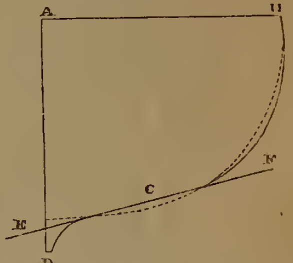
By referring to equation (1), we find that the displacement, area of midship section, and the construction water-line, being known, the exponent of a parabola that coincides most nearly with the line of sections is easily found; and we shall have (putting M for the midship section) the value of

$$n = \frac{\text{D}}{l\text{M} - \text{D}} \ldots\ldots\ldots (a).$$

This value of n shows the degree of fulness of the ship.

The parabolic method may also be applied to show the relative fulness of the midship section, of any of the water-lines, of the displacement with respect to the water-line, and of several other elements.

Fig. 3.



Let ABC (fig. 3) represent a midship section, and let EF be a tangent to the curve at the point of contrary flexure C; the small area ECD, not being of any importance, may be neglected. If the midship section is at all similar to those usually given to ships, a parabola may be assigned which shall pass through the points B and C, and have nearly the same area with the midship section, and also nearly coincide with the curve, so that the exponent will afford means of ascertaining its relative fulness.

Call the breadth of the water-line AB $= \frac{1}{2}$B, the depth AE $= h$, and the area ABE $= \frac{1}{2}$M, and let m be the exponent of a parabola having the same area; then

$$\frac{m}{m+1} \cdot \tfrac{1}{2}\text{B} \cdot h = \tfrac{1}{2}\text{M}; \text{ and } m = \frac{\frac{1}{2}\text{M}}{\frac{1}{2}\text{B}h - \frac{1}{2}\text{M}} = \frac{\text{M}}{\text{B}h - \text{M}} \ldots\ldots\ldots (5).$$

In the same manner, the exponent may be found for the water-line, by supposing a parabola with its vertex as the greatest breadth, and passing through the points in which the water-line cuts the middle line. Suppose the exponent of this parabola $= r$, the length on the water-line $=$ L, and, as before, the breadth $=$ B; also let the area of the water-line $=$ W; then

$$\frac{r}{r+1} \cdot \text{L} \cdot \tfrac{1}{2}\text{B} \cdot = \tfrac{1}{2}\text{W}, \text{ and } r = \frac{\text{W}}{\text{BL} - \text{W}} \ldots\ldots\ldots (6).$$

Lastly, suppose the areas of the several water-lines, from the load water-line downwards, to decrease in the proportion of the abscissas to a parabola; and let the exponent $= s$, the depth from the water-line to the tangent of the midship section $= h$, the displacement $=$ D, and the area of the water-line $=$ W; then

$$\frac{s}{s+1} \cdot \text{W}h = \text{D}, \text{ and } s = \frac{\text{D}}{h\text{W} - \text{D}} \ldots\ldots\ldots (7).$$

We cannot better conclude these remarks than by giving, from Mr. Creuze, a table of the actual dimensions of several of the vessels in the British navy, which will better illustrate the subject of scantlings than anything we could say on that subject.

TABLE OF SCANTLINGS OF SHIPS IN THE BRITISH NAVY.

Number of guns	120	84	76	74	Razée.	74	Razée.	60	46	42	28	Fir. 28	18	18	10	Cutters.		Steam Vessels.	
Burthen in tons	2808	2279	1925	1741	1741	1614	1614	1474	1073	943	499	499	429	382	235	160	108	296	237
	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
Length of the gun-deck of ships of the line, and flush-decked vessels; and lower deck of frigates	205 5½	196 5½	182 0	176 0	176 0	168 0	168 0	172 9	151 9	145 0	113 8	113 8	109 6	100 0	90 0	70 8⅜	60 9	126 0	115 0
Length on the keel, for tonnage	170 11	161 11½	150 8⅞	145 1	145 1	137 10½	137 10½	144 9	126 8	121 9⅜	94 8⅜	94 8⅜	86 9½	77 3½	75 7	52 3¼	49 5	111 9¾	101 2⅞
Breadth, extreme	54 6	51 5¼	49 0	47 6	47 6	46 11	46 11	43 8	39 11	38 2	31 6	31 6	30 5	30 6	24 6	24 0	20 4	22 4	21 0
Breadth, moulded	53 9	50 8¼	48 4	46 10	46 10	46 3	46 3	43 0	39 3	37 6	31 0	31 0	30 0	30 0	24 0	23 7	19 11	21 10	20 7
Depth in the hold	23 2	22 6	20 6	21 0	14 0	19 9	13 3	14 6	12 9	13 3	8 9	8 9	12 9	12 9	11 0	11 0⅜	9 0	13 6	11 0
Main wale, thickness used in the calculations	0 10	0 9	0 8½	0 8½	0 8½	0 8½	0 8½	0 7½	0 6	0 6	0 5	0 5	0 4½	0 4½	0 4	0 3½	0 3½	0 5	0 4
Plank of the bottom	0 5	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 3	0 2½
Depth from the lower edge of the rabbet in the keel, to the lower side of the false keel	2 3	1 7	1 9	1 9	1 9	1 9	1 9	1 6	1 3½	1 3½	1 4	1 4	..	..	1 8	1 3½	0 11½	0 9	0 7
Midship port above the water	5 6	5 6	5 6	5 8	8 8	5 4	7 4	8 0	6 0	7 0	4 9	4 9	4 6	4 6	4 2	4 1½	3 6	..	..
Draught of water when loaded, or with the above height of midship port from the water — forward	24 8	22 9	21 4	21 6	18 10	20 6	18 6	20 0	18 0	17 8	14 6	14 6	10 0	10 0	10 10	8 9	7 0	9 9½	7 2
abaft	26 1	25 9	23 4	23 6	20 2	22 6	20 6	20 0	19 4	18 8	15 6	15 6	13 2	13 2	12 5	13 6	11 0	9 9½	7 2
Draught of water when launched — forward	15 1	13 2	14 2	13 0	12 6	12 2	11 8	12 2	10 6	10 6	9 6	8 8	5 0	5 0	7 3	6 4	5 0	5 1	4 9
abaft	18 4	18 0	17 11	17 9	16 2	17 7	16 0	15 2	14 6	14 1	12 5	11 9	8 9	8 9	9 5	9 8	9 0	6 5	5 2
Displacement when loaded, measured to the mean draught of water in each body — fore-body, in tons	2400	1960	1576	1552	1268	1352	1152	1128	852	764	403	344	257	228	149	83	55	218	128
after do.	2320	1880	1526	1476	1136	1272	1064	1012	740	696	365	324	249	216	142	93	54	190	103
Sum of the displacements of the two bodies	4720	3840	3102	3028	2404	2624	2216	2140	1592	1460	768	658	506	444	291	176	109	408	231
Difference of the displacement of the two bodies	80	80	50	76	132	80	88	116	112	68	38	20	8	12	7	10	1	28	25
Displacement when launched — fore-body, in tons	1280	1024	960	880	780	760	676	568	436	408	225	144	136	108	78	53	41	87	68
after-body, do	1120	824	824	720	640	624	544	472	324	320	180	120	96	70	57	31	22	68	52
Sum, or weight of the hull	2400	1848	1784	1600	1420	1384	1220	1040	760	728	405	264	232	178	135	84	63	155	120
Difference between the load and the launching displacements, or the absolute burthen, in tons	2320	1992	1318	1128	984	1240	996	1100	832	732	363	404	274	266	156	92	46	253	111

Number of guns	120		84		76		74		Razée.		74		Razée.		60		46		42		28		Fir. 28		18		18		10		Cutters.				Steam Vessels.			
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Length of the vessel at the load water-line, that is, between the fore side of the rabbet of the stern and the aft side of the rabbet of the stern-post	205	3	195	9	182	0	176	0	175	4	168	3	168	0	173	6	153	0	145	3	115	0	115	0	106	9	97	3	87	2	66	0	57	0	120	5	108	4
Extreme breadth at the load water-line	55	6	52	2¼	49	9	48	3	47	9	47	8	47	8	44	3	40	3	38	6	31	10	31	10	30	3	30	3	24	8	23	8	20	6	22	8	21	3
Mean difference between the load and launching draughts of water . .	8	8	8	8	6	3	7	1½	5	2	6	7½	5	8	6	4	6	2	5	10½	4	0½	4	9½	4	1	4	8½	3	3½	3	1½	2	0	4	0½	2	2½
Distance of the centre of gravity of the displacement below the load water-line	10	0	8	10$\frac{8}{10}$	8	2½	8	1$\frac{2}{10}$	6	0	7	7$\frac{6}{10}$	6	10$\frac{8}{10}$	6	8$\frac{8}{10}$	6	9	6	6	4	10$\frac{8}{10}$	4	6½	4	1$\frac{2}{10}$	4	0	3	6	3	0	2	8½	3	3$\frac{6}{10}$	2	5¼
Distance of the centre of gravity of the displacement before the middle of the length of the load water-line	2	0	1	4$\frac{3}{10}$	1	9	2	0	2	0	2	1$\frac{2}{10}$	2	0	2	9	3	3½	1	11½	1	7$\frac{2}{10}$	1	7$\frac{2}{10}$	0	7$\frac{9}{10}$	0	8	0	5½	0	0	0	8$\frac{4}{10}$	3	2$\frac{4}{10}$	2	0
Distance of the principal transverse vertical section before the middle of the length on the load water-line	18	0	13	6	8	6	20	0	14	4	15	6	13	3	8	6	10	0	15	0	15	0	15	0	13	0	8	6	8	0	2	0	5	6	10	6	8	6
The same distance in proportion to the length of the load water-line . .	·088		·869		·041		·11		·081		·092		·08		·049		·065		·10		·13		·13		·12		·087		·091		·03		·098		·087		·079	
Area of the principal transverse vertical section, in square feet . .	1056		988		810		802		658		740		646		616		540		500		320		280		241		241		164		138		102		166		104·8	
Area of the load water-section, in square feet .	10012		8960		7952		7608		7176		6916		6672		6704		5260		4776		3264		3160		2632		2368		1796		1232		948		2400		1894	
Displacement per inch at the load water-section, in tons	23·83		21·33		18·9		18·1		17·09		16·46		15·9		15·96		12·52		11·37		7·77		7·52		6·27		5·63		4·28		2·9		2·26		5·7		4·5	
Area of the launching water-section, in square feet	8440		7176		6760		6280		6048		5812		5570		5336		4008		3760		2808		2288		2160		1680		1360		880		740		1808		1610	
Displacement per inch at the launching water-section, in tons	20·0		17·1		16·1		14·95		14·4		13·83		13·26		12·7		9·54		8·95		6·68		5·45		5·0		4·0		3·24		2·09		1·75		4·49		3·83	
Area of the sails, viz. jib-driver, courses, top-sails, and top-gallant sails, in square feet . .	25619		26724		24226		23027		24374		23027		24374		23027		16651		16107		10152		10152		9605		9277		6246		4825		3502		. . .		. . .	

Art. IV.—ARTESIAN WELLS.

The supply of water from Artesian wells,* which continue flowing in an apparently never-ending stream, without the trouble of drawing or pumping, seems so much more convenient than the supply derived from wells of ordinary construction, that to many it may appear strange this plan of procuring water is not universally adopted. The small expense of boring, compared with the operation of sinking a well, also increases the surprise that Artesian wells do not altogether supersede the common mode of procuring water. It is not unfrequently imagined that the flowing of water from an Artesian well is owing to the small size of the aperture; and that the fluid is, in some manner, by capillary attraction, drawn up to the surface. A short consideration of the ever-flowing stream, and of the circumstances requisite to produce it, will show that only in certain localities, favoured by the elevation of the surrounding country, and by the character of the subjacent strata, can the advantages of a supply of water by Artesian wells be attained. The well-known law of hydrostatics, that fluids find their level, obtains in no case more rigorously than in the spouting up of water from Artesian wells, though, at first view, it appears to contradict that law.

As a necessary condition to success in boring for an Artesian well, there must be a reservoir of water above the level of the ground whence it is expected to flow. There must also be interposed, between that reservoir and the upper surface, a stratum of clay, or of other substance impermeable by water; otherwise the fluid would ooze through the whole soil, and cover it. When these circumstances are known to exist, by geological examination of the surrounding country, success is certain; and the depth to which it may be necessary to bore before reaching the water can be determined with a near approach to accuracy, by measuring the thickness and the depth of the strata. To render more intelligible the positions and character of the strata requisite to the formation of an Artesian well, let us imagine a number of basins, gradually increasing in size, to be placed within one another, and the interstices to be filled with sand saturated with water. The central basin we will suppose to be empty, and to represent a valley resting on a bed of clay, surrounded by hills of sandstone and chalk, which form concentric strata, separated from each other by strata of clay. It is evident, that were it not for the uppermost bed of clay, the valley would be flooded by the water with which the sand of the higher surrounding ground is saturated. Again, were it not for the lower strata of clay, the water would drain off, and the sand would be left dry. In the case assumed, however, the water is retained by the impermeable clay, and is heaped up above the level of the valley. Wherever this upper bed of clay is pierced through the water consequently rushes out, in the same manner as it would rise into the middle basin, were a hole drilled through the bottom or the sides; and the water would continue to flow until the level of the fluid contained between the two impermeable strata was lowered to that of the aperture. Let us suppose the middle basin to be strewed with sand to the depth of about an inch, and we shall then perceive the distinction between Artesian and common drainage wells and the sources of their supply in such a situation. The rain that fell within the area of the middle basin would percolate through the sand, and be collected between its particles at the bottom, whence it could not escape. The foundation bed of clay on which the soil of the valley rests would hold in the water; and, on sinking a well through the soil, a supply would be found. It is very evident that this water could not rise to the surface, and that the supply must be limited to the quantity that falls within the area of the valley. Not so, however, with regard to the supply drawn from the lower reservoir to which the Artesian well penetrates. The porous surface exposed between the two concentric impermeable strata may extend over miles of country; nearly all the rain that falls upon it would, therefore, be stored in that vast reservoir; and, when bored into, it would afford a supply to the valley drawn from far-off lands. By boring still deeper we may arrive at the reservoir collected from the drainage of country more remote and extended.

The situation of the province of Artois, in France, is peculiarly favourable to boring for these artificial springs, and from that district they have obtained the name of Artesian wells. The position of the strata under Paris led M. Arago to the conclusion that if they were bored through to the underlying green sand, an abundant supply of water would be obtained, which would rise above the surface. After several years of persevering labour in the Abattoir of Grenelle, the boring tool, when at a depth of 1,800 feet, struck into the expected green sand, and a torrent of water instantly rushed up the aperture, and rose above the surface to the height of 50 feet. The quantity of water thrown out amounts to 400 gallons per minute, and the quantity it is expected will be increased when they have succeeded in protecting the sides of the bore by a tube reaching from the surface to the bottom.

Many parts of the Vale of Thames are favourable to boring Artesian wells, and the whole of it would be so were not the edge of the strata intersected by the river near Greenwich, where the subterranean reservoir between the beds of clay overflows before reaching the requisite level. A well, to supply Mr. Munday's brewery, was sunk at Chelsea to a depth of 394 feet, principally through clay, and when the boring tool pierced to the sand the water rushed up with great velocity, and rose to a height of 200 feet. In sinking a well at Kensington Gravel Pits, at a depth of 236 feet, the water rushed in upon the workmen in a similar way, and continued rising until it overflowed it, and afforded an abundant supply of water. If this well had been bored instead of being sunk, the result would have been the same, and a constant flow of water would have been obtained at a much less expense. On the banks of the river, near Thames-street, deep wells have been sunk, in some of which the water overflows, and in others it rises to within a few feet of the surface. At Sheerness, a very deep well was sunk, which, after penetrating through beds of clay and of sand, which yielded only salt water, the well-diggers came at length to an abundant spring of fresh water that rose to within five feet of the top. At the village of Northall, a well was sunk to the depth of 164 feet through strata in the following order: first a bed of clay 60 feet thick, a layer of stone one foot thick, clay again of the thickness of 29 feet; this was succeeded by sand 23 feet thick, but no water issued, as might have been expected. The sand was found to rest on another bed of clay 51 feet thick, after penetrating which the water gushed into the well, and rose near to the surface.

When it was proposed, a few years since, to supply London with water from wells sunk into the chalk below the level of the valley of the Colne, various opinions were expressed by scientific men respecting the probability of deriving an adequate supply from that source. Mr. Webster, the geologist, founding his opinion on the nature and position of the strata, denied that the chalk underlying the London clay is "the great water bearing stratum." Mr. Robert Stephenson, on the contrary, entertained the opposite opinion, founded on numerous experimental researches, and also on his knowledge of the nature of the chalk formation derived during the execution of the works of the Birmingham railway. Mr. Webster conceives that the source of supply of the Artesian wells in London and its neighbourhood is drawn from the sands above the plastic clay. Mr. Stephenson admits that in the construction of Artesian wells in and about London, the supply does come *immediately* from the plastic clay sands, but he adds, "this does not militate against my conclusion, that the reservoir formed by these sands is supplied principally by the absorption of rain through the medium of the chalk, which occupies far more extensive areas (at its "outcrop") than the plastic clay sands. The facts adduced by Mr. Stephenson show that *below the level of the sea* the chalk forms a vast reservoir of fresh water, and that far above that level the rain, which falls on the surface of the chalk, is constantly draining through towards the lower reservoir, where the water is retained by the stratum of clay under the chalk. This reservoir, however, lies much deeper than the reservoir formed by the plastic clay, and its upper level, below which the water will not drain, is also much lower. It is evident from the preceding statement of the conditions requisite for the construction of Artesian wells, that the level of the surface of the stationary subterranean reservoir must be higher than the aperture whence the water flows, and as this does not appear to be the case in the chalk formation surrounding the metropolis, we cannot agree with Mr. Stephenson in thinking that the Artesian wells near London are supplied from the water in the chalk, for no instance occurs of the water rising to the surface of wells sunk into that stratum. The plastic clay, which retains the water in the stratum of sand above it, would also effectually cut off the supply of water from the chalk, even were the permanent level of the fluid in the latter higher than that of the water in the plastic clay sands. Though the supply of water in the chalk under London is much greater than that on the stratum of sand above it, the water requires to be drawn to the surface at whatever level the wells into it are sunk, whilst the permanent level of the smaller reservoir in the stratum of sand is rather above that of the general surface of the Vale of Thames.

Art. V.—A RHAPSODY ABOUT CONTRACTS.

Engineers' specifications, and contractors' estimates, a subject of considerable interest to those whom it may concern, and to be treated with some delicacy by those whom it does not, is one that has arrested our attention, and excited certain embryo musings in our breast; to which we fear we shall only be able to give utterance in certain half-intelligible, half-incoherent intonations.

Be it marked, in the first place, that the word Engineer, as here used, is rather to be taken in its conventional than its true meaning. It denotes a certain class of functionaries, to whom it rather pertains to keep a staff or body-guard of engineers among their retainers, than to exercise, in their own illustrious persons, the proper functions thereto belonging. Like the officer who was "no soldier," these engineers would blush to be thought mechanics. They are, however, "all honourable men," and might appropriately be termed "honorary engineers," just as we have honorary directors; or, to use another comparison, just as we have sleeping partners in a firm,—those who are understood to put their money into the concern,—so we should hear of sleeping engineers—meaning those who do little else but take money out. They seem designed to fill a place analogous to what bishops do in the Church—give half-yearly or quarterly charges to their constituents, better known as "Reports;" and might with propriety be termed Ruling Engineers, just as we have ruling dignitaries, in contradistinction to working or menial clergy. Thus it comes to pass, that we have Pneumatic Engineers, Dock-warehouse Engineers, Hydronomical Engineers—not to speak particularly of those who assume the title of "Engineer and Ditcher," or "Engineer and Sexton." (The next step we suppose will be, "Engineer and Washerwoman.") "Engineer and Old Woman," though not generally printed so at length among the title-page honours, is a union already sufficiently common; and it is, we believe, on this description of engineers that the task of drawing up specifications frequently devolves.

In perusing some of these documents, we have been reminded of the picture in Syntax's History of Napoleon, representing the Emperor signing his abdication, while a British officer stands before him with a couple of primed pistols. They rather resemble terms of surrender dictated by a victorious general to some beleaguered city—a deed of unconditional capitulation imposed, at the point of the sword, upon some conquered people, which none, save those compelled by fire and famine, would think of submitting to—than a fair bargain between two equally independent parties.

The specifying engineer seems to take for granted, that the entire herd of tendering or constructing engineers are either a set of absolute novices, who not only need to be informed as to what is really wanted, but require, besides, to be minutely instructed in all the niceties of their own craft—or else a crew of designing knaves or simpletons, constantly bent on exercising their utmost ingenuity in cheating their employers, and ruining their own reputation, by passing off insufficient workmanship. We approve of contracts being distinct, and would not quarrel with their being needlessly precise; but we condemn the sort of latitudinarian, one-sided strictness, which binds the tenderer or contractor to every thing, and the party specifying to nothing at all; an agreement, in short, wherein the constructor deliberately makes over to the specifier the absolute and irresponsible power of completely ruining him at his very good pleasure, or, rather, very good spite, as the case may be. Of course the engineer of the company will get great credit from his constituents for such a business-like, or rather lawyer-like procedure: but the effect is, just to drive the fair trader out of the market, and leave the matter in the hands of those who rely more for success upon their personal influence over the engineer, their bullying or cozening powers—or it may be their talent for dialectics and trick—than on exact adherence to the terms of the contract. Nay, we doubt not that many such contracts are taken under the firm conviction that the engineer will not have the hardihood or the imprudence to adhere strictly to the letter of the engagement. Nice calculations are made upon the moral probabilities which the character of the engineer affords of this or that discretionary or arbitrary power being exercised or forborne, and the contractor concludes by entering into an agreement, on the moral certainty, almost absolute assurance, that the other party to the agreement will not insist upon its rigorous fulfilment. Perhaps gambling is the most appropriate name for transactions of this description.

We may give one very simple example of the contract indefinite, but yet all on the one side. The contractor, in a certain estimate now open, is required (under a penalty, of course) to deliver a certain heavy amount of work in three months or less. This is like the old story of the oath with an "et cætera" in it. "Or less" may mean three weeks, or three days, or three minutes. Another specifying engineer coolly informed the writer of this, who had occasion officially to make inquiries with the view of tendering, just after advertising for offers, that it was pre-arranged that the lowest offer should not on any consideration be accepted. "The thing," said the engineer, "is quite absurd; it never is done, and shall not be done in the present instance: no, sir, we avoid extremes, and have resolved to accept the medium offer." Would that there were more such cognoscenti! We might allude to certain other engineers of the last-mentioned class (viz., combining the vocations of engineer and old lady,) who do not scruple to give some of the most practical and useful iron-founders in the country a complete code of laws and bye-laws, for the formation of sound, perfect, and sufficient castings, who, judging from appearances, would greatly prefer to have a work spoilt according to rule, than perfected without the help of their recipes. Such gentlemen can talk with amazing fluency about granular texture and fibrous configuration; are quite at home in the various properties of the various cardinal numbers, 1, 2, 3, 4, and 5; and have long ago decided, commutably, if not infallibly, the respective merits of the hot and cold blast. We only wish some of them would try to make their own goods for their own markets.

ART. VI.—THE COAL-FIELDS OF GREAT BRITAIN.

THERE are few subjects of greater public importance than the consideration of the extent of the depositories of coal in this country; for upon the continuance of the supply of that fuel depends the manufacturing prosperity, and with it the national existence, of Great Britain. The quantity of coal extracted annually from the collieries of England, Wales, and Scotland, amounts, it is estimated, to upwards of thirty millions of tons; and, as coal does not *grow*, it is evident that a time must come when the existing stores will be exhausted, if the consumption continue in the present ratio. The nation appears to be, in this respect, in the position of a man who is living on his capital: every year it is diminishing, and, sooner or later, it must come to an end, unless death in the mean time stop the demand.

To enable those who are unacquainted with geological science to form a notion of the nature and probable extent of the resources of the country in mineral fuel, it will be necessary, in the first place, to state some of the fundamental facts which have been established by geology, and to describe the arrangements and positions of the general strata, as they are observed in England and Wales more particularly.

It has been well ascertained, by concurring observations in most parts of the world, that the external crust of the globe is composed of the same series of rocks, which, it is supposed, were originally deposited in succession one over the other. The lowest rock of the series of which we have any knowledge is granite: it is therefore considered the foundation whereon all the other rocks and strata are deposited. Resting immediately on the granite is a series of rocks which have been called *primary*, from their supposed order of formation. They consist chiefly of a slaty kind of granite, known by the barbarous name *gneiss*, of mica slate, quartz, hornblende, and crystalline limestone. In these rocks no remains of vegetables or animals have been discovered; therefore it is concluded that they were formed prior to the existence of life of any kind on the globe. They all bear indications of igneous origin, and have a crystalline texture. The next in the series are the slate-rocks of various kinds, the old red sandstone, and carboniferous limestone. These rocks are less crystalline than those of the primary formation, and among them are found numerous remains of marine animals of the lowest order. The rocks of this class are supposed to have been formed when the globe was undergoing a change preparatory to the existence of animals of a higher order; hence they have received the name of *transition rocks*. The primary and the transition formations contain most of the metallic ores, which are the most abundant in the slate and the carboniferous limestone. Upon the latter rock generally rests the coal formation, which comprises a distinct series of strata of an average thickness of about 3000 feet. These strata consist of beds of coal of varying thickness, alternating with layers of sandstone, indurated clay, and slaty clay called shale and ironstone. Among the coal are found numerous remains of vegetables, most of which are similar to those of tropical climes. It is worthy of remark, also, that remains of similar plants are found in the regular coal formations of all parts of the globe; whence it may be inferred that the general temperature of the earth at the period of the deposition of the coal was much higher than it now is in this latitude. The rocks and strata, from the lowest primary to the coal, seem to have been deposited on one another in regular succession, without interrupting the dislocation of their conformable position by internal convulsions of the globe; but before the strata which rest upon the coal were formed, numerous convulsions must have occurred, which greatly disturbed the whole of the primary and transition series; upheaving them in some places, and depressing them in others. This fact is ascertained by the frequently unconformable position of the *secondary strata*, which rest generally upon the coal formation. The coal strata, for example, are sometimes elevated nearly vertically when the strata resting upon them are horizontal. The secondary formation consists of sandstone, clay, limestone, oolite, sand, and chalk. Over these are deposited the *tertiary strata*, in which are found remains of terrestrial animals, of more perfect organization than those in any of the subjacent formations. The tertiary strata for the most part consist of alternations of clay and sand. The London clay constitutes one of the characteristic features of this formation, the total thickness of which is estimated at 400 feet. The alluvial and diluvial deposits of the upper soil cover over, and in level countries conceal from view, all the successive formations which, so far as man's knowledge can penetrate, compose the crust of the globe.

Nothing approaching to an accurate estimate can be formed of the thickness of all the rocks and strata resting on the foundation granite. In some countries nearly a whole formation is deficient; and in different parts of the same country the corresponding strata will be of various thicknesses. Professor Playfair supposes that if all the formations were fully developed they would exceed thirty miles in depth; that is, the inhabitants of London, resting on the tertiary formation, would have to sink down perpendicularly for thirty miles ere they could arrive at the granite;—assuming all the strata in their fullest developement to be carried horizontally underneath. This estimate is, however, much greater than other geologists allow. The thickness of the tertiary and secondary formations resting upon the coal, can, however, be measured with tolerable accuracy. The strata of the secondary formation, including the chalk, are estimated by M. de la Beche to be 6250 feet; the tertiary strata are about 400 feet thick; their thickness under London, before reaching the chalk, is about 300 feet; therefore, were we to sink a shaft perpendicularly, we must penetrate to the depth of 6500 feet at least before we could reach the coal formation, and we should still have to descend probably some hundreds of feet before we could reach any seams of coal. The deepest coal-pit in England scarcely exceeds 1200 feet; consequently it would be impossible, with the present means of operating, to reach within one-fifth the distance at which coal might be obtained under London.

It is evident that if the rocks and strata had remained in the horizontal position in which there is good reason to believe they were originally deposited, the stores of coal and metallic ores contained in the earth would have been unknown to man. But the lowest of the rocks have been brought to the surface by numerous internal convulsions, which have upheaved the granite, and, in many instances, forced it through all the superincumbent strata,—laying the several strata exposed in succession on the inferior elevations of mountain ranges. A great convulsion of this kind has upheaved the primary rocks along the whole extent of the western coast of England, and in Scotland, forming the Devonshire, the Welsh, the Cumbrian, and the various ranges of the Scotch mountains. The whole of the strata of England have by this means received a general elevation towards the north-west; and in passing along the country from London to North Wales, the subjacent strata appear on the surface in succession. The substratum of clay is shortly succeeded by sand; we then come to an extensive range of chalk hills; next to freestone, limestone, clay, and sandstone; and, on arriving near Birmingham, we enter upon the coal formation, which is the uppermost of the transition series. A little beyond Shrewsbury the lower transition and primary rocks present themselves; and as we advance farther west, we reach the protruding granite.

The accompanying geological map of England presents a more clear idea than any merely verbal description could convey of the general localities of the different formations of rocks and strata. The parts marked I I I round London, and extending to Norfolk, and in Hampshire, indicate the positions and extent of the tertiary strata. Beyond these, the unshaded space, extending to the boundary line marked S S S, shows the district occupied by the secondary strata. In the central portion of the island, shaded on the map with horizontal lines, the upper transition series of rocks and strata come to the surface. This tract of country forms a belt, of irregular breadth, extending from Northumberland on the north-east, to the boundary of Cornwall and Devonshire on the south-west, branching off from Gloucestershire along the whole of the southern coast of Wales. In this extensive district all the principal coal-fields of England and Wales are situated; they are distinguished on the map by dark shading. The most valuable mines of iron and of lead are also situated within the same range of country. To the west of the boundary lines, marked P P P, the lower transition and primary rocks rise to the surface from under the upper transition series; the perpendicular lines indicate the positions where the primary formation has been elevated to the surface. In the North of England the primary rocks stretch completely across the island, with the exception of a comparatively small tract of transition strata round Whitehaven, and extend into the southern counties of Scotland, forming the range of Lammermuir hills. Soon after passing the Scottish border the transition series again appears. It occupies a district extending from south-west to north-east, of about forty miles in breadth. The extreme north-eastern point to which these transition rocks reach is St. Andrew's, and to Girvan on the south-west. This tract is very rich in coal and iron: it is characterised in the map by the same shading as similar formations in England. The granite of the Grampian hills rises to the north, and occupies, with few insignificant exceptions, the other portions of Scotland. In addition to the great convulsion of nature by which the granites of Devonshire, North Wales, Cumberland, and Scotland, have been elevated above the superincumbent rocks, other internal commotions of minor extent have protruded the granite to the surface in several parts of the country. The granite of the Malvern hills, the Charnwood Forest hills, and of the Wrekin in Shropshire, are examples of these local protrusions of granite, which have deranged the positions of the strata in the vicinity, though the effect has extended over a much smaller area.

It is not our object at present to do more than give such an outline of the geology of Great Britain as will illustrate the formation, the relative positions, and the probable extent of the coal-fields; yet we must not omit to mention the basaltic rocks, which in many parts of the country cover all the other strata, and appear at first view to contradict the theory which geologists have endeavoured to establish, of the successive depositions of the strata at different progressive epochs of creation. The basaltic rocks are evidently of igneous origin; they contain no traces of animal or vegetable remains; and their constituent parts are closely assimilated to those of the primary rocks: therefore they possess all the inherent qualities to entitle them to be ranked among the primary formations. Their position, however, altogether forbids such a supposition; for they rest upon the tertiary strata, sometimes spreading over extensive areas, and occasionally rise to great elevations, covering the subjacent rocks to a height of even thousands of feet. The igneous nature of the rock, its resemblance to many lavas, and the unconformable position in which it is deposited, point clearly to the mode by which it has been formed. The numerous seams of basaltic rock which have been discovered in working mines, rising in nearly a vertical direction through the dislocated strata, and descending to unknown depths, indicate that the basaltic covering has been ejected from below in a molten state; that it has forced a passage through the strata above, and has flowed like streams of lava over the surrounding lands. In all mining operations, especially in working coal-seams, the miner frequently encounters a vein of basaltic rock, which effectually cuts off the seam of coal, and brings him to a stop. After penetrating through the wall of basalt he does not find the coal-seam on the same level as before. The strata on the opposite side have been elevated by the basaltic lava in forcing its passage, and the miner has to seek for the coal-seam he was working at a different level. In the section representing the usual position of coal strata, in the accompanying plate, the nearly vertical bed which rises through the strata represents the position and effects of one of these protruded walls of basalt, which are known by the miners as "faults." On one side of the fault, it will be observed, all the strata and seams of coal are represented to have been lifted up above their former level, and some of the upper have been entirely lost; for the ground above exhibits no sign of the strata having been upheaved on one side of the fault more than on the other. What has become of the lost strata, and by what means the surface has been levelled after such a convulsion, are questions to which no perfectly satisfactory solution has been given.

It might, perhaps, be supposed, from the generally observed regularity in the succession of the different rock formations, that the districts where the coal strata come to the surface would correspond in the same country at least, and that each would contain beds of coal of the same thickness and of the same quality. But we have already stated that the rocks which form a characteristic feature of one series of strata are sometimes altogether absent in the corresponding strata of a different locality, and that the thickness of any given stratum frequently varies very materially. These variations from the general system, which obtain in the ordinary succession of rocks, are still more remarkable in the coal formation, which consists of successive layers of earthy and of vegetable matter, deposited, as is supposed, at distinct intervals in the beds of large freshwater lakes. The quantity of vegetable matter deposited must have depended on the nature and elevation of the soil surrounding the reservoirs into which the forests were engulphed, and subsequently mineralized. It is evident that, as the nature of such depositions must necessarily vary with the varying localities, no regular order of succession could be expected in the quantity and quality of coal in the different coal-fields of Great Britain; and in many parts of what is termed the "coal formation," no coal is to be found. It will be advisable, therefore, to avoid misconception, to explain the meaning of the terms "coal formation" and "coal-field."

The *coal formation* consists of a great number of strata, some of them not more than one inch thick, composed alternately of layers of shale, or clayey slate of various kinds, of ironstone and sandstone, and at irregular, uncertain intervals are seams of coal resting on the shale. This series of strata generally rests on the carboniferous limestone, and it lies under the new sandstone of the secondary formation: when fully developed the coal formation is 3000 feet thick. Where this series of strata exists it is not unreasonable to expect that coal will be found before boring to a depth of 200 yards; but, unless there be some more certain indication of the existence of coal than the presence of the series of shale which compose the coal formation, such an experiment would be very hazardous.

A *coal-field* is formed by a series of strata, including seams of coal, peculiar to the district in which coal is found; for each district, though bearing a general resemblance to others, has distinguishing differences of its own, not only in the number and thickness of the seams of coal, but in the succession and general disposition of the strata, and the foundation rocks whereon they rest. The usual form of the strata of a coal-field is that of a basin, each stratum lying within the stratum beneath it, like one basin placed within another. The section of coal strata at the bottom of the geological map of England represents a coal-field of this conformation cut through by a basaltic "fault," which has upheaved the coal strata on one side of it. From the concave shape of the coal seams and their accompanying strata, they are not unfrequently called *coal basins*. It will be observed that the strata must come to the surface all round such a coal basin. This is termed by the miners "cropping out," and the calculations respecting the extent and the value of coal-fields are often deceptive, in consequence of the seams terminating in this manner on the surface.

It will be seen on the map, that, though the district of the upper transition strata, among which is the coal formation, occupies a larger portion of the country, the coal-fields, where coal is known to be within attainable depths, appear only in patches. There is reason to believe that coal could be found in most parts of that district at lower depths, but it is covered by the upper sandstone, and marl of such a thickness as to render the attempt to obtain coal generally impracticable with our present means of working. In marking the positions and the extent of the coal-fields of England, in the accompanying map, we have adhered to that of Mr. Arrowsmith, published with the report of the House of Commons on the Coal Trade. It must be observed, however, that in thus mapping out the extent of the coal districts, no account is taken of the frequent "cropping out" of the strata, nor of the many interruptions by faults, which cut off the seams of coal; consequently, the parts marked on the map as within the range of coal-fields would often be found to contain no coal. We can in such matters only hope to attain an approximation to correctness; and, we believe, that in its general features this representation of the extent of the coal-fields of England is near the truth.

In Mr. Arrowsmith's map, the coal-fields of England are classed in twelve divisions, ranged in the following order. 1st. The Northumberland and Durham, which supplies with coal the North and East of Yorkshire, the whole of the coast stretching from Newcastle to Plymouth, extending inland to the counties of Bedfordshire, Hertfordshire, &c.; and the whole extent of country from London to the north and east coast. This coal-field, which is the most important, not only on account of its extent and depth, but for the excellent quality of the coals, occupies an area of not less than 1,300 square miles. It is estimated that there are about 730 square miles of coal in Northumberland and Durham still unworked, and that the average thickness of the coal is twelve feet. The coal strata in Northumberland dip under the sea. The second coal field is that of Yorkshire, which reaches from near Leeds to Nottingham. It is sixty miles long, and of the average breadth of eighteen miles. The coal is principally consumed in the counties in which it is wrought. In this coal-field, there are thirty different beds of coal, varying in thickness from six inches to eleven feet; the total thickness of the coal being twenty-six yards. Third, in order, is the comparatively small coal-field of Whitehaven, which supplies great part of the counties of Cumberland and Westmoreland. It is estimated to be about thirty miles long, and of the average breadth of three miles. The great Lancashire coal-field is very irregular in its form, extending from near Liverpool to the hills which separate the two counties of Lancaster and York. The area of the whole is estimated at between 400 and 500 square miles. All the manufactories of Lancashire and part of Cheshire are supplied from this source. The North Staffordshire coal-field consists of two coal basins, which occupy together an area of sixty square miles. The beds of coal are very thick; they supply the potteries, and some of the Staffordshire foundries. The sixth, or South

Staffordshire coal field, is divided into four districts; one of which extends under Stourbridge, Birmingham, Wolverhampton, and Walsall, occupying an area of seventy square miles. The next occurs ten miles east of the former, and extends from Tamworth to Coventry, being twenty miles long, by an average breadth of three miles; north-east of the latter, there are two small coal basins which occupy about thirty square miles. The coal in the great South-Staffordshire coal basin is thicker than in any other in the kingdom; one bed of coal near Dudley is thirty feet thick, but it is believed to be of limited extent. The demands upon the mineral fuel of this coal field to supply the numerous foundries and manufactories are so great, that it is supposed this district will be exhausted before any other. The Shropshire district, including Coalbrooke-dale, comprises two coal fields, which occupy about ninety square miles. The Forest of Dean coal field, the eighth in Mr. Arrowsmith's order of arrangement, is of an oval form, of the average diameter of six miles; a great part of Gloucestershire and Herefordshire are supplied from this district. The Bristol district, which lies between that city and Bath, is twelve miles long, ranging from north to south, and is about three miles wide. The country it supplies is very limited, for even at Bath it has to compete with the coal from the Somersetshire field. The latter is the most southerly point at which coal is obtained in England. It occupies a curved tract of about eighteen miles long, and three broad. A great part of the country west of London, is supplied from the collieries in this district. The coal field of North Wales comprises four coal basins, three of which are situated within the north-eastern confines of the country, the other is in the isle of Anglesea, which, though too distant to be properly included in the same district, is nevertheless too small to form one of itself. North Wales and part of Cheshire draw their supply from these coal basins. The last, and, perhaps, most important reservoir of coal, is the South Wales coal field. Its length is upwards of 100 miles, and the average breadth in the counties of Glamorgan and Caermarthen is from eighteen to twenty miles; in Pembrokeshire its breadth is diminished to four miles. In this extended area, there are twenty-three beds of workable coal, the total average thickness of which is 95 feet, and it is calculated to yield sixty-four millions of tons of coal per square mile. The thickest of the beds is 9 feet. A great part of the coal in this immense basin, is of the kind, now commonly called anthracite. It is composed almost entirely of carbon, and contains no bituminous matter, consequently, it does not blaze, and is difficult to ignite. By the application of the hot blast, this kind of fuel, which not many years since was considered of little value, is rendered more suitable for the iron furnace than any other; and yields more iron, and of better quality, from the same weight of ore than common coal.

Having now stated the extent of the coal fields of England and Wales, in the order assigned in Mr. Arrowsmith's map, we shall proceed next to consider their probable duration. This question must necessarily be one of great uncertainty, for it depends not only on the questionable estimates of the quantity of unwrought coal, but on the ever-changing circumstances which regulate the demand. The opinions on this subject, of the witnesses examined before the Committee of the House of Commons, and of miners and geologists, are widely different. The Northumberland and Durham coal field affords the best means of estimating the consumption, and probable duration of the coal. The annual consumption from those collieries exceeds five millions of tons; the total consumption of coal in Great Britain, being estimated at thirty millions of tons. Mr. Bailey, in his survey of Durham, considers that the northern coal districts will be exhausted in 200 years. Professor Sedgwick, extends the duration to 300 years; whilst an agent of the Northumberland coal proprietors, who was examined before the House of Commons, conceives they will last for 1700 years. Professors Buckland and Sedgwick agree in stating 400 years to be the limit of the duration of coal in all the known coal fields of England. The vast depository of coal in South Wales, however, remains almost unworked, to supply all demands for centuries after the coal of England is exhausted. Each square mile contains sufficient coal to supply the annual consumption of Great Britain, and 1,200 square miles are comprised within the area of the South Wales coal field. The most apprehensive patriot, therefore, need not alarm himself at the prospect of the national ruin if it can be averted for 1,600 years.

We have not yet taken into account the coal fields of Scotland. The tract of country between the hills on the border, and the Grampian mountains in the north, which reaches from sea to sea, belongs to the upper transition series of strata, and is peculiarly rich in coal. It might, indeed, be considered as an immense coal field, seventy miles long by forty broad, but we have marked on the map only those districts where coal is known to abound, and where productive collieries are in operation. In the pits near Haddington, the beds of coal are 9 feet thick, and this may be taken as a specimen of the great Lanarkshire coal field, in which the pits are situated. In Clackmannanshire, the north-eastern boundary of the coal district, there are twenty-four beds of coal, varying in thickness from two inches to five feet. The Paisley coal field is covered by greenstone, a rock of igneous origin, which has been erupted through the surface, and covers the subjacent strata to the depth of 100 feet. After penetrating through this hard rock, the miner arrives at a soft sandstone, which is succeeded by clay slate, under which are found ten beds of coal lying immediately over one another, not less altogether than 100 feet thick! The abundant stores of fuel in these coal fields have been hitherto inadequately worked, and Scotland imports as much coal as she exports; but should the resources of England fail, a ready and ample supply might be opened in North Britain.

Art. VII.—NEW STRAIGHT AXLE ENGINES ON THE GRAND JUNCTION RAILWAY.

Plate XXII. is a representation of a straight axle engine employed upon the Grand Junction Railway, and is very similar to those alone used on the line between Paris and Rouen. Some of the sizes of this particular example, are as follow:

Inside fire-box, 2ft. 8in. long, 3ft. 6in. broad, 3ft. 5in. above bars.
Tubes, 139 in No. 1 $\frac{3}{16}$ outside diameter, 8ft. 6in. long.
Smoke-box 2ft. 1in. long, 4ft. 1in. broad.
Cylinders 13in. diameter, 20in. stroke.
Force pumps, plunger 2in. stroke 20in.
Driving axle, Journals 5½in. diameter, 6in. long.
Connecting rod, 5ft. 0¼in. long, 2¼in. diameter at ends.

It will be remarked that the cylinders are placed upon the top of the framing at a slight angle: these engines are, therefore, but little broader than those with cranked axles. The framing is made entirely of iron plate and angle iron, and is very strong. Next month, we intend giving a drawing of the gearing, &c. of this engine, and will then take the opportunity of discussing its merits, as compared with engines of the ordinary kind.

Art. VIII.—MASLEN ON THE IMPROVEMENT OF TOWNS.

Suggestions for the improvement of our Towns and Houses. By T. J. Maslen, Esq., many years a Lieutenant in the Army. London: Smith, Elder, and Co. 1843.

We expected but little of Mr. Maslen, on reading his title page, and we have not been disappointed. Not that a gentleman who has been many years a lieutenant in the army, must necessarily be a nonentity, though, to speak the truth, there is something in the inference; but that a person who thinks it worth his while to append to his name such a distinction, can hardly be supposed to be very rich in sterling merit. We, consequently, find Mr. Maslen to be a sort of literary phenomenon; his egotism and simplicity are marvellous, and he talks as if he had lived all his life in fairy land, where towns may be demolished and palaces built up by the single wave of the wand of a magician. If Mr. Maslen could only give us proof that he had possession of the lamp of Aladdin, we should be willing to pronounce his suggestions excellent: until then, we very much fear, they must rest in the realms of Utopia. Our readers, however, will best judge of the extent of the demolition Mr. Maslen would commit, by a few extracts from his book, and they may take the following:—

"We should recommend that all that block of houses in the rear of the Mansion House, inclosed between Cannon-street, Walbrook, and St. Swithin's-lane, be pulled down, and the whole space be planted with shrubbery and grass, and inclosed by a railing of musket-barrels on a low wall, painted green."

"The Fleet Prison should be pulled down, and Farringdon-street should have two rows of trees (olives) planted along the edge of both foot-pavements. Considering the little thoroughfare there is in Farringdon-street, and its capacious width, a few rows of trees would help to fill up the vacant prospect."

"Holywell-street and Wych-street should both be pulled down, together with Lyon's Inn, Clement's Inn, and New Inn; and the whole of this capacious space of ground should be surrounded by private lodging-houses, at low rents; and the ground in the middle be laid out in a retired garden and quiet retreat from the noise of the Strand, and be called Royal Square, for the working classes."

"Shoreditch and Norton Folgate should be widened and colonnaded till it meets the proposed Houndsditch Quadrant."

"Several one-sided small streets should be erected, in various parts of the city, at pretty regular distances from each other, and continued in a series from the East end of the town to the West end, to consist wholly of stables and stalls for gigs and carriages; which would enable people who reside out of town to put up their horses, &c., close in the vicinity of their counting-houses and shops."

"King-street and Queen-street, in the City, both require widening all the way from the iron bridge up to Guildhall. It has been recommended to build a new front to Guildhall. We cannot acquiesce in the recommendation; it would be a pity to destroy the present venerable-looking Gothic front. It is not a new front that is wanted, but a more extended front; but the front cannot be extended unless the buildings on each side (forming salient wings) be pulled down; and as the Hall looks pinched up in a narrow nook, it would be a grand improvement to make the front three times its present width, in the same Gothic style of building, and to widen King-street proportionally thereto."

"The clearing away of Shire-lane, and all the courts, alleys, passages, and holes in that locality, would be an excellent operation upon that sick part of London, and 'heal the sores thereof, for it shaketh.'"

"The following would be a really useful improvement, to join Whitechapel-road to Oxford-street: viz., begin at Gray's Inn or Furnival's Inn, in Holborn, and drive a wide street through all the blocks of houses from thence to West-street, commonly called Chick-lane; widen the latter, and drive a wide street from thence to the west end of London-wall; widen the latter, and drive a wide street from thence to Wentworth-street; widen the latter, and continue the wide street till it opened out into Whitechapel-road, near the London Hospital."

> "I should recommend about ten acres of ground to be cleared in the rear of the Mansion House, and have it laid out in walks, studded with statues, planted with small standard-trees (no flower-beds), and seats fixed in various places: and if a fountain, on a handsome scale, could be contrived in it, it would be a delightful spot in the very heart of the City, well deserving the title of Elysium. The Field of Mars should be an open level plain, of about twelve acres, perfectly square, and always be clean gravelled and kept free from grass, vegetation, trees, and every intruding obstacle. It might be situated anywhere in the parish of Whitechapel."

We might fill our pages with such extracts, but must refrain; we cannot, however, resist the following, which in absurdity overtops all the others.

> "I recommend Government to begin the building of ten new cities in England, each intended to contain 300,000 souls, and to be colonized from the old cities; the legislature to grant two millions stirling a year, for twenty years, for the building department. The plans of the cities to be drawn on paper, with every improvement that science is capable of suggesting, and engraved, and afterwards marked out on the ground, to the extent and space calculated for the above-mentioned amount of population; every street in a new city to have only four houses in it at the first set off, namely, one house on each side the street at the top and bottom, just to show the two lines of foot pavement, and the width of the street. Each city to he planted in the centre of the most barren, hungry, impracticable, useless, waste land."

We really think, that if Mr. Maslen had his way, scarce a vestige of our present towns and cities would be left. It is not improvement be advocates, but renovation; and the shortest way to carry out his suggestions, would be to fire all the houses in the kingdom, and reconstruct them from the ruins. We take leave to recommend Mr. Maslen, when he has schemes of improvement to propose for the future to pay some attention to the trivial condition of practicability; at present he is manifestly too fond of those agreeable abstractions which people usually term building castles in the air.

Mr. Maslen, however, has not omitted to give us certain credentials of his capacity, and here they are.

> "I beg to state, that although I am not an architect, I have had almost as much experience as many a person who is one professionally. From the early age of sixteen, my most favourite studies and drawings, at a school in France, were plans of houses and towns, fortifications and maps, and the five orders of architecture; and this fondness for architecture accompanied me through life, and impelled me to attend all the new buildings and new streets that used to spring up like mushrooms around London when I was a youth. The exceedingly deep and strong foundations of the Bank of England, in Bartholomew-lane, first gave me a notion of strength in building. My father (who was a partner in the firm of Bingley, Pitt, and Maslen,) wished to bind me to an architect; but I longed to go abroad, and at length obtained an appointment for India; and, in that fairy-land of castles and palaces, I allowed no opportunity to escape me of seeing a great variety of buildings constructed, diligently attending their daily progress, in whatever part of India I happened to be. I saw some of the stupendous bomb-proof magazines and stores erected in Fort St. George; stone barracks at two or three other places; immense bridges at Beypour and Seringapatam; besides innumerable smaller buildings. It will scarcely be said that I have not gained some experience in the subject I presume to treat of."

The announcement in the title page was something, but this is evidence irresistible; but so generous is Mr. Maslen of his proofs on this head, that he adds in a note that he was also an industrious draughtsman, and gave away 150 of his own drawings in India. Who, after this, can doubt that he is a man of genius? We greatly fear, however, that such genius as his is likely to be dissipated by a cool climate, and the antiphlogistic regimen.

We might amuse our readers with many of Mr. Maslen's bursts of eloquence, and his attempts at wit, did our space permit. They may, however, take the following *morceau.*

> "Foot-bridge over the Thames. There is a scheme in progress to erect a foot-bridge across the river opposite Hungerford-market, which I very much regret; for it quite spoils the view up and down the river, already sufficiently intercepted by a sufficient number of bridges. Surely the Southwarkites cannot be so badly off for fish that they must take the Strand fish-market by storm in this manner. Why should they *ford* the river at that particular spot, and *hunger* after the Strand fish, when they might form a Strand on their own side, and build a *Hunger-ford* market there, if they had a molecule of spirit in their hearts, or an animalcule of wisdom in their phreno-mesmeric upper stories, or a decimal shilling in their well-buttoned inexpressibles? I denounce the intended foot-bridge, and prophecy that it will be taken by storm by the genii of the winds, or be carried away by the aerial steam-carriago, soaring along on the wings of Boreas and Æolus!"

It must not be supposed, however, that there are no useful suggestions in this work. The propositions to form streets alongside the river has often been brought forward, and is in our judgment a wise and practicable improvement. Upon the expediency of carrying out this plan, Mr. Maslen insists, and adds to it the proposal to form a number of new parks, and to connect all the parks of the metropolis by Boulevards. Of this proposal, we think very highly. We give it, and the preceding in Mr. Maslen's own words.

> "The clearance of the buildings from the banks of the river in Westminster and in the City being effected, wide streets should be formed along the river side, from Westminster-bridge to the Tower, and from the Tower to the Isle of Dogs; consisting of handsome lofty houses, facing the water, at the distance of 150 feet, and a river parade, paved and planted along the water's edge, fenced with a low balustraded wall.
>
> "The river streets should be on the same level as the present Temple-gardens, and pass under arches at the ends of the different bridges, (in the same way as Thames-street passes under the arch of London-bridge,) because the bridges are of so preposterous a height, that people cannot enjoy the sight of the water from them; and if the streets were to be raised to that height, it would utterly ruin the effect and the pleasures intended.
>
> "These new Thames-streets, or river-parades, would be the grandest and most healthful alterations and improvements that were ever effected in London.
>
> "Secondly,—A boulevard, or circumferential street round London, is a great desideratum; but the plan of it is so connected with the parks, that we will offer a few suggestions respecting the latter.
>
> "Victoria-park, at the north-east end of London, is already planned; and it is understood that Finsbury-park and Lambeth-park are also decided upon; but there should be two or three more small parks made, besides the above three, if it were for nothing else but to prevent the increase of the metropolis, otherwise millions of houses will be built, and so enlarge the suburbs, joining them to the City, that London will be like a kingdom of itself in a few hundred years more, so overgrown and unweildy will it become.
>
> "The other sites which should have parks to stop the spreading pestilence of house-building and house-crowding, are, 1st, one at Pentonville; 2nd, one at Hoxton; 3rd, one between Stepney and Bromley; 4th, one at Walworth; 5th, one at Rotherhithe; and 6th, one at Deptford; making, with the three of Finsbury, Lambeth, and Victoria Park, a total of nine new parks, entirely encircling the metropolis. This would be better than two or three large parks, as these small parks would divide the pleasure and recreation of such places more equally and more beneficially to the wide-spread population of the metropolis; and the scenery afforded by them would render the approaches to London, from various quarters, extremely beautiful.
>
> "There is another consideration regarding the forming of many parks, which must not be lost sight of; and that is, where are the numerous regiments of London volunteers, amounting to 200,000 men, to be drilled and manœuvred, in any future war with France, if we permit every open space, every field, every corner and cranny of the metropolis to be built upon for miles round?
>
> "To revert to the Boulevards: the North Boulevard should be a connecting avenue from one park to another, consisting of a broad raised road, planted with several rows of trees on both sides, and forming splendid malls or drives, encompassing the northern portion of the metropolis; beginning at the Green-park, and from thence passing Kensington-gardens to the north-west angle of Hyde-park, thence to the Regent's-park, and from the latter in a straight line to Victoria-park, embracing in its course Pentonville-park, Finsbury-park, and Hoxton-park; and from Victoria-park to Stepney-park, and thence down to the new Quay-street at the Isle of Dogs (or proposed new Fort Waterloo).
>
> "The South Boulevard in like manner forming an avenue and mall, or drive, from South Lambeth-park to Walworth-park, thence to Rotherhithe-park, thence to Deptford-park, and thence to Greenwich-park."

We here conclude our extracts, and bid adieu to Mr. Maslen: before we next meet with him, we trust he will have mingled more with men of his own standing in society, so that he may find his proper level, and cease to think like a child, and to write like a bashaw.

ART. IX.—REMARKS ON CUTTING, EMBANKING, AND OTHER EARTHWORKS.

No part of engineering science is entitled to more attention than the subject of earthworks. They constitute about one-third of the whole cost of railways and canals, and their stability and substantial execution are obviously of the highest importance, as affecting the permanent value and success of the undertakings of which they compose so large a part.

The general subject of earthwork immediately divides itself into two branches. The one has reference to the original design of the works, and embraces the whole question of slopes, drainage, and the formation of embankments. The other has reference to the mode of execution, supposing the work determined on, and embraces the consideration of the most economical and judicious methods of effecting the excavation, removal, and embankment of masses of earth according to their several varieties of structure and composition. The former of these branches belongs strictly to the province of the engineer; the latter to that of the contractor. The present remarks will be confined to the consideration of the former, or, more exclusively, engineering part of the subject; and the latter part will only be occasionally introduced in so far as it claims the attention of the engineer in the actual laying out and designing of his works.

Preparation of Designs for the Execution of Earthwork.

The principal undertakings which embrace those large operations connected with the execution of earthworks may be arranged under the following heads:—roads, canals, railways, ponds, docks, harbours, reservoirs, &c. All these works are characterized by many different circumstances peculiar to the locality in which they may happen to be situated, and to the nature of the material to be dealt with. Several of the works here enumerated, however, may be classed together with respect to the general character of the earthworks of which they are composed. For instance, the earthworks required in the formation of new roads, railways, and canals, have all their main features in common; and our attention will now be directed to a brief description of these features, and the best methods of representing them on paper.

The several kinds of cutting which are common to railways, canals, and roads, are the following:—cuttings on the main line, to furnish material for making the embankments; cuttings on the main line which are not required for embanking on the line, and are therefore placed in spoil banks; side cutting taken from adjacent lands to form embankments where there is a deficiency of stuff on the main line.

In laying out the levels of a canal, or the gradients of a railway or road, it is always a matter of nice and careful investigation so to arrange and balance the cuttings and embankments, that the cost of cutting down and removing each separate mass to its allotted place in the embankment shall not exceed the minimum which the circumstances admit of. This remark has reference merely to quantities and distance of carriage; but it will be shown hereafter that, in order to the judicious execution of a work, there are other circumstances connected with the kind of material to be deposited in particular embankments, which ought to claim a prominent share of the engineer's consideration.

Plan, longitudinal section, and transverse sections.

In order to afford contractors the means of estimating the quantities and cost of earthwork, the engineer always furnishes what is called a plan and a longitudinal section; the former to exhibit the situation and relative positions of the several cuttings, embankments, and spoil-banks, if any; the latter to show the several lengths and depths of the cuttings and embankments. These two documents, the plan and section, will furnish, in some few cases, all that is required for calculating the cubic contents of each cutting and embankment, and the distance of carriage to which all the stuff has to be removed. In such cases, therefore, the plan and longitudinal section will be sufficient for the purposes of estimating as far as quantities, distances, and levels are concerned. We have said that these cases are few; and the truth of this will be recognized when it is considered that the longitudinal section alone will only furnish accurate measurements for the quantities, when all the lines drawn on the ground across the centre line of the cutting, and at right angles to such centre line, are absolutely horizontal. Whenever such lines are horizontal, the work is technically called level cutting, and the longitudinal section taken along the centre line may be relied on as giving the fair and correct depths for calculating the quantities. When, however, the lines so drawn on the ground across the centre line are not horizontal, the cutting is termed a sideling or sidelong cutting; and the longitudinal section alone will not furnish heights or depths which can be relied on. For instance, if the axis or centre line of the work lies in a valley, the longitudinal section will represent smaller depths than those which should be used to arrive at correct quantities. If, on the other hand, the axis passes along the ridge or saddle of a hill, the depths shown by the longitudinal section will be too great. And, lastly, as an intermediate case, if it passes along any kind of sloping ground, as on the side of a hill, or a valley, the depths shown on the section will also be manifestly erroneous, and incapable of furnishing that accurate basis required by the contractor in framing his estimate. These remarks apply to cuttings, but the case is much the same with respect to embankments; the difference here being, that when the axis of an embankment lies in a valley, the centre line shows greater depths than the true ones; and when it lies along the ridge of a hill, it shows smaller depths than the true ones. Thus similar errors are produced in the two cases by opposite circumstances; that same variation in the levels of the ground, which, in the case of a cutting, would occasion an error of excess, giving rise to one of deficiency in an embankment, and *vice versâ*. Seeing, then, that in every instance where the ground is not absolutely level on each side of the axis, an erroneous result will be arrived at, if the longitudinal section alone be taken, it can scarcely be necessary to say that in all such instances cross-sections, otherwise called transverse sections, should be supplied for the purpose of making correct calculations of the quantities. Where no such cross-sections have been made, and the ground presents such variations as have been described above, it is quite certain, either that the company executing the work must be injured, by having to pay for too great a quantity, or the contractor must suffer for the indiscretion of neglecting to test the accuracy of the engineer's representations.

In large works, where the variations of the ground are considerable, it is no uncommon thing to find that the quantities computed from the longitudinal section alone will differ by several thousand cube yards from those which are calculated with the assistance of accurate cross-sections. This may occasion a difference in the estimate, one way or the other, of several hundreds or even thousands of pounds, and is, therefore, well worth the attention of engineers when they are letting large earthworks by contract. It is difficult to conceive why a subject of so much importance in the execution of earthworks should be very generally neglected by the same engineers who are remarkable for elaborate detail in the specifications and drawings referring to the masonry and other departments of their works. It has not unfrequently come under our observation, that, in a set of contract drawings, every part of the smallest bridge has been drawn with so much of what Mr. Vignoles would term the most finical exactness, as even to include and define trifling ornaments, mouldings, or details, in the manner of execution which, if left to the discretion of the contractor, could not possibly affect the cost more than a few shillings; and, in the face of all this, the sections referring to the earthwork have been so imperfect, that the true value of the work could not be arrived at within a thousand pounds or more. All this is surely very inconsistent, and ought to be remedied.

We have hitherto been speaking of natural irregularities in the surface of the ground, which are commonly met with on the site of almost all large cuttings and embankments; and it is to the neglect of transverse sections in such cases as these, that the attention of our readers has been directed in the preceding paragraphs. With respect to those irregularities which are produced by large pits, quarries, old canals, and other works of art adjoining the site of the proposed work, few engineers would pass over circumstances of this kind without having them particularly shown by transverse sections. The London and Croydon Railway, which is constructed, for a considerable distance, close to the line of the old Croydon canal, is an example of a work where transverse sections in great numbers were required to show the area of the railway cutting at every place where it touched upon the excavations or banks of the old canal. Accordingly, the contract drawings, for a considerable part of this line, comprised an abundance of such sections, which were made particularly useful to contractors by having the areas in all cases marked on the sections. These areas having been previously computed with great accuracy in the engineer's office, were used by the contractors as a check upon their own quantities, and a great deal of time was thus saved in the framing of their estimates. A similar practice was followed by many engineers in laying out the old canals upon sidelong ground.

Computation of Quantities.

Before leaving the subject of transverse sections it may be proper to distinguish certain erroneous methods of computing the cubical contents of earthwork. Many contractors, and others, have thought that if they take the mean area, that is, the arithmetical mean between the areas of two adjacent sections, and multiply this by the distance between them, the product will be the cubic content of the block or mass between the two sections. This, however, is very far from being correct. Others, again, are in the habit of taking the arithmetical mean of the depths of cutting in two adjacent sections, and from this mean calculating an intermediate area, which they multiply by the distance to obtain the cubic content, as before. This gives a different result from the preceding method, but still not a correct one. The error in the first case is one of excess, in the latter of defect; and it is remarkable that the error of the first method is exactly double the error of the other.

By adopting the first erroneous method the contractor makes his quantities greater than they should be; and by adopting the second he makes them nearer to the truth; but in this case the error is against himself. All who are familiar with the use of the prismoidal formula in calculations of this kind will readily see the nature of the errors made in assuming an average area. As it forms no part of the present design to treat upon the mensuration of earthwork, we shall only briefly observe, that the correct method of finding the cubical contents between any two adjacent sections is the following:—Find the area of a section half way between the two given sections, by calculating from the half sum of the depths in the same way as the area is found for the latter of the two erroneous methods described above. Then multiply this intermediate area by 4, and add to the product the areas of the two given sections. One-sixth the sum of these three areas will give the true mean area, which may then be multiplied by the distance for the cubic contents of the block.

Scales for Earthwork Plans and Sections.

The scales made use of for the plans of earthwork contracts vary from five chains to an inch, or 16 inches per mile, to two chains to an inch, or 40 inches per mile. The longitudinal scale of the section must of course be the same as that of the plan, and the vertical scales which are employed range from 10 feet to an inch to 40 feet to an inch. The transverse sections are sometimes made to the same scales as the longitudinal plan and section; but when the ground is very irregular they should be plotted to a larger scale. Many engineers divide the longitudinal section into lengths of one chain by vertical blue lines, so that the heights being taken at each division, the cubic quantity per chain is readily found either by calculation or by one of the tables used to facilitate the process. It will be unnecessary to say more on the construction of earthwork plans and sections, as specimens of these documents, taken from the contracts of the principal railways, have already been published in some recent works on surveying.

Balancing the Cuttings and Embankments.

When a section is put into the hands of a contractor for the purpose of making his estimate, the specification sometimes contains particular instructions as to the disposition of the stuff, the contents of each cutting being assigned to fill a particular embankment; and the positions of the several spoil-banks and side-cuttings being also particularly pointed out. In other cases general stipulations only are made that the ground shall be cut down and made up to the several depths and heights shown in the longitudinal section; and that the work, when finished, shall present the several inclinations, levels, gradients, &c., which are represented on the section. In the former of these cases the contractor has no alternative but to follow the specified directions; and nothing is left to his judgment or discretion with respect to the disposal of any part of the stuff. In the latter case his judgment has to be exercised with reference to the most economical and judicious means of filling each separate embankment, and of disposing of the material from each separate cutting.

The problem of balancing the cuttings and embankments to the best advantage is one of considerable importance, and requires accurate preliminary calculations of the cost of filling from side cutting compared with that of carrying stuff from cuttings on the line to embankments which exceed a certain distance. The data for determining this problem have entirely altered within the last few years, that is, since the introduction of the great railway cuttings and embankments. These large works have caused the introduction of steam power for the haulage of earth upon iron-edge rails; an improvement which has so much reduced the price of transport, as completely to overturn the system of balancing which was practised by the old canal engineers, and which many have persisted in thinking equally applicable to the works of railways.

In the early canals of this country, engineers had so great a dread of large earthworks, and particularly of the cost of carrying the stuff any great distance to embankment, that extensive circuits were made to avoid such works; locks were introduced much more frequently than if the contrivances of modern engineering had been known, and tunnels were prolonged till they came out at a depth so inconsiderable, that open cutting would have been much cheaper. Some of these expedients to reduce the magnitude of their earthworks, and particularly the expedient of introducing locks, instead of carrying the canal in excavation at a deeper level, have been accompanied by lasting injury, and inconvenience to the navigation; to say nothing of the delay produced by circuitous routes, and by the immense number of locks to be passed through, the summit level was in many cases made so high that constant pumping power had to be employed in raising water to find the highest reach of the canal. The late Mr. Telford lowered the summit levels of several of the canals executed by Brindley, and other early engineers. Till within the last few years, it was not only held to be of the utmost importance in canal and road-works, to adjust the cuttings and embankments so that the one should just make up the other with the least possible distance of carriage; but it was held an object worthy of close investigation to balance even the cross section of canals on sidelong ground, so that the cutting on one side would just make up the bank on the other, under which circumstances the excavated stuff would be either cast into its place, by the fly tool, or wheeled by barrows without the assistance of horses. The problem of determining the depth of cutting in sidelong ground, which would give an area of cutting in the upper side just equal to that of the unbanking on the lower side, has been treated at considerable length in the principal Encyclopædias. One or more of these articles are attributed to an engineer of no less eminence than the celebrated Mr. Nimmo. The necessity for such minute calculations has been entirely removed, since modern practice has shown the perfect facility and comparative economy with which earth can be carried to embankment a distance of five or six miles.

Suppose the cuttings and embankments on any given line are accurately balanced, as it is called, so that the one will just make up the other, but that in order to this, the distance of carriage, or length of lead, must in some cases be very considerable. It then becomes a question, partly of time and partly of expense, whether it is better to carry the stuff from the cuttings so great a distance, or to resort to side cutting nearer to the embankment, and throw the surplus cutting on the main line into spoil? The question of expense must be decided according to the particular circumstances of the case, involving a calculation of the cost of each separate alternative, and no general rule can be laid down to fix the distance beyond which it becomes inexpedient to carry the stuff right forward to embankment on the main line. Even if the strictly engineering part of the subject could be reduced within the limits of a general rule—which it obviously cannot, owing to the immense variety of soils, the improbability that the cutting on the main line and the side cuttings would consist of the same stuff, and the varying expense of horses in different districts—the cost of the land for the deposit of spoil, and for the proposed side cuttings, would still form an important element in the calculation, which, of course, will vary on almost every separate line, and probably on many different parts of the same line. Hence, no general rule can possess any value, and the whole must be left to the judgment of the engineer, based upon calculations made to suit the particular case. The advantage in point of time is, of course, always in favour of the spoil bank and side cutting system, because it it is evident, that both cuttings and embankments can be executed in much less time when they are respectively to be worked and supplied from the extensive faces afforded by this system, than when the working faces have no greater area than that which the cuttings and embankments themselves afford. Hence, the method of making up embankments by long leads on the main line will always occupy more time than the method of filling from side cutting; but whether the difference of time in any particular case is sufficiently important to weigh much in deciding between the two, depends entirely upon the degree of importance attached to the rapid execution of the particular work in question. In a future paper, we shall, probably, have something to say on the time occupied in the execution of earthworks under different circumstances.

Method of finding the lead or distance of carriage.

In estimating the length of lead from a section, it should be borne in mind, that the true distance for any given mass of cutting is the distance from the centre of gravity of that mass to the centre of gravity of the embankment to which it is to be carried. If we conceive a cutting and embankment each with upright sides instead of slopes, the centres of gravity of the areas represented in the section would be at the correct distance from each other. But in consequence of the peculiar figure usually given to earthworks, in order to secure their stability, it follows that the centre of gravity will almost always be within the mass of any great prominence, either in the cutting or embanking, which gives a just depth at that place, and will, in fact, never lie in the same point, which would be correct if the work were bounded by upright sides. It is not usual to make use of any mechanical or other contrivances, to find the centre of gravity in estimating the lead in earthwork; because, when the peculiarity above mentioned is duly considered, this can mostly be done with sufficient accuracy by inspection. At the same time, to neglect the difference between the prismoidal form of the masses, as occasioned by two pairs of converging planes, and the more simple kind of solid, which would have only one pair of converging planes, would lead to serious and objectionable errors.

Alteration of earth when placed in embankment.

In any system of balancing cuttings and embankments, and in all calculations relating to the mass of embankment, which will be made up by a given quantity of the other, it is important to make allowance for the expansion of some material when put into a bank, and the shrinkage of others. It is familiar to most persons, that on the one hand, the stuff from a rock cutting, which consists of fragments having large interstices between them, will occupy a much greater bulk in bank than in its naturally close compact state; and on the other hand, the light wet peats and bog earths will shrink into less than half the bulk which they occupied in the cutting.

From experiments and observations made by Mr. Ellwood Morris, an American engineer, it appeared that the shrinkage of yellow clayey soil was at the rate of 102 yards in every thousand taken from the cutting, and in another variety of this clay, the shrinkage was at the rate of ninety-three yards in a thousand. In light sandy soil, he found the shrinkage 129 yards in a thousand, and in gravelly earth, eighty-three yards per thousand. The following general results may be deduced from the experiments detailed by Mr. Morris.

In yellow clay, taking the mean of the two experiments, 1000 yards of cutting formed 902 yards of embankment, or 1000 yards of embankment required 1113 yards of cutting. In light sand, 1000 yards of cutting formed 871 yards of embankment, or 1000 yards of embankment required 1148 of cutting. In gravelly soil, 1000 yards of cutting formed 917 of embankment, and 1000 yards of embankment required 1091 of cutting. The mode of applying these results in practice will be obvious. Thus, let C represent any mass of cutting, aud E any mass of embankment.

Then,

In yellow clay, ·902 C = quantity of embankment which will be formed by C.
,, 1·113 E = quantity of cutting required to form E.
In light sand, ·871 C = quantity of embankment which will be formed by C.
,, 1·148 E = quantity of cutting required to form E.
In gravelly soil, ·917 C = quantity of embankment, &c.
,, 1·091 E = quantity of cutting, &c.

Mr. Ellwood Morris also extended his inquiries to two varieties of rocks, the one a hard sandstone quarried in large fragments, the other a blue slate, which broke up into small pieces. By reducing the experiments into the form shown above, it appears that,

In the hard sandstone, 1·432 C = quantity of embankment, &c.
,, ·698 E = quantity of cutting, &c.
In the blue slate, 1·597 C = quantity of embankment, &c.
,, ·626 E = quantity of cutting, &c.

In one of his earlier lectures, Mr. Vignoles made some observations on the subject of compression in bank which are somewhat at variance with those of Mr. Morris. He says, that sand and gravel will occupy the same space in bank as in the cutting, a remark with which we are inclined to coincide, except for very wet gravel, which will shrink in embankments, and for very large gravel, which will probably occupy more space in bank. Mr. Vignoles states examples in which 1000 yards of cutting had only made 830 yards of embankment; but upon an average, he observes, it would require 1100 yards of clay to form 1000 of embankment. According to Mr. Vignoles, therefore, 1·100 E, is the quantity of cutting required to make a volume of embankment equal to E. In this result, he comes very near to Mr. Morris, whose average for yellow clay is, 1·113 E. Mr. Viguoles, also gives an example of the increase of rock cutting in bank, from which the following expressions are deduced.

1·200 C = quantity of embankment formed by C.
·833 E = quantity of cutting required to form E.

In all experiments upon the shrinkage of earth in bank, it is important to know in what manner the bank was formed, whether in shallow layers, which were successively compressed by the earth wagons travelling over them, or in one or more deep lifts, according to the more modern practice in railway embankments. If the bank has been formed in the first of these ways, it will certainly arrive at its least settlement in less time than in the other; and, in either case, an observer should be quite certain in measuring the bank, that it really has arrived at its greatest amount of consolidation. Neither of the authorities above quoted give any information upon the latter point, but Mr. Morris states, with respect to his embankments, that they were formed in layers by cart and scoop. Upon the whole, the information which we possess on the subject of settlement and increase of earth in embankment is very imperfect, and the circumstances connected with it should therefore be accurately observed by the engineer on every possible opportunity.

Art. X.—CHURCH OF THE HOLY TRINITY, AT HULME.

On the 28th of June ult., was consecrated the church of the Holy Trinity, situated in the township of Hulme, in the parish of Manchester, by the Lord Bishop of the diocese.

This church has been erected from the designs of Messrs. Scott and Moffatt, architects, Spring-gardens, London; and it is one of the most successful adaptations, although not by any means a perfect adaptation, of the style which prevailed about the middle of the thirteenth century (temp. Henry III.) The plan is in the form of a cross, consisting of nave, aisles, and transepts, and it has a good tower at the west end; the chancel, we are sorry to say, is very short, indeed so much so as to appear nothing more than a recess from the centre of the two transepts. There are no galleries for the accommodation of the congregation, and only a small one at the west end, which projects from the tower-arch, for the organ and choir. The accommodation provided for amounts to about 900 kneelings, 250 or 300 of which are free. The pews are made so as to appear as much like free sittings as possible, and they are not encumbered with any doors. The south-west external view is very chaste and beautiful, opposed to which is the north-west ditto, facing the street, and from that circumstance it is very much overdone with ornaments, so much so as to destroy all repose and good keeping. The details throughout are also much too heavy.

This church will certainly be of great benefit to the neighbourhood in which it is erected, as it is one of the most increasing of the suburbs of Manchester.

The township is indebted for this church to the munificence of Miss Atherton, who has both built and endowed it at her own expense, she having vested the superintendence and presentation in the hands of the Rev. the dean and canons of the collegiate church, Manchester.

The cost for erecting this church cannot be much less than £7,000, and the endowment amounts to £4,000.

Art. XI.—LIFE ASSURANCE.

A short Treatise on Life Assurance, with the Rates of all the Offices in London. By Frederick Lawrance, Esq. London: Richardson. 1843.

We have several times intended, since the commencement of our career, to say something on this important subject, but have been prevented by the pressure of other subjects which have a more urgent demand upon our time. Even now our remarks must be few and brief; but we trust at no very distant time to be able to give more space and attention to the subject than we can now afford, assured, as we are, that it is well deserving of our regard and solicitude.

There are a vast number of ways of assuring a person's life; but the most common mode, or, at least, the mode in which our readers have most concern, is by paying into the assurance-office a certain sum per annum, in order that a corresponding value may be obtained at the subscriber's death. A mechanic, for example, by paying a very small yearly amount, might enable his family to obtain such a sum at his death as would leave them in comfortable circumstances. In this way, every person who has a fixed income, by apportioning a small part of it to the assurance of his life, may relieve himself of all anxiety respecting those whom he desires should, in the event of his death, experience no pecuniary difficulty. The system, as compared with that of savings' banks, has this great advantage, that it puts a person's mind at rest at once. Any one who begins to pay into a savings' bank for the purpose of making a provision for his family, has the apprehension continually upon him that he may die before he has accumulated such a sum as will shield his family from penury. But any one who assures his life in the desired amount has no further solicitude, as, if he were to die the next moment, his family would become entitled to the sum for which he was assured. This will perhaps be made plainer by the following exposition of Mr. Lawrance:—

"A person, aged twenty-four, wishing to secure to his family 100*l.* at his death, *whenever that event should happen, if only one minute has elapsed after the completion of the transaction* (that is, by payment of the money), he would have to pay annually to the office; say, 2*l.* 3*s.* 5*d.*; this sum of 2*l.* 3*s.* 5*d.* is called the '*Premium of Assurance.*' Lest my readers should imagine that I am putting a supposititious case as to sudden death, I will take this opportunity of mentioning that a few years since, a Colonel in our own service, anxious to make a provision for his children at his decease, proposed to effect, and was accepted by one of our best offices in London, for a sum of 5000*l.* to be paid at his death, whenever that event occurred. He paid his *first* year's premium at the counter, and '*died on the door-steps of the office the same hour!*' The office of course paid the 5000*l.* to his family, although they had only received 200*l.* as a consideration."

Mr. Lawrance's work explains the various kinds of assurance upon lives which may be effected, and the various collateral uses to which such assurance may be rendered subservient.

Art. XII.—RAILWAY REFORM.

Railway Reform: its Expediency and Practicability considered: with copious Appendices, containing a Description of all the Railways in Great Britain and Ireland. London: Richardson. 1843.

This is one of the ablest productions that for a long time has come across our path, and is destined, we can foresee, to inflict a serious wound upon our railway monopolies. It abounds in facts and figures, on which, indeed, all its arguments are founded, and makes out a case against the present mode of administering the railways of this country, such as is not, we conceive, to be resisted. Who the writer is we cannot, of course, say; but he speaks as one having authority, and manifestly possesses a familiar acquaintance with the details of railway management, and with the essence of railway statistics. In short, this essay, both in the force of its arguments and the speciality and exactitude of its information, is worthy of any member of any department of the Board of Trade; and General Pasley will require to look to his laurels, if surrounded by such able competitors.

In our last Number we drew the attention of our readers to the enormous difference between the cost of railway transit in England and on the continent, and deduced from thence the inference that there must be something essentially vicious in the voluntary system of railway administration which has become universal in this country. The cost of railway travelling in England is considerably more than twice greater than in Belgium, notwithstanding the longer experience and greater facilities enjoyed by the former in the execution of railway works. The consequence of this state of things is, that the English public is deprived of a large proportion of the benefit due to the introduction of this new mode of transit; and the poorer classes of the community are nearly deprived of the means of travelling altogether. All this, however, is so much better stated by the author of the work before us than we could do, that we prefer giving his expositions to our own.

"In the establishment of railways here and on the continent, two widely different systems have been acted on, and by comparing the principles on which each is founded, and the results, we shall be enabled to form some idea of their comparative merits. The railway system in this country is one of private commercial enterprize; the capitalist is induced to invest his money in an undertaking which he knows must supersede the ordinary channels of communication throughout the country, and which, therefore, he has good reason to suppose will yield him a large per centage on his investment. He considers it merely in the light of a speculation, and one like any other which he is justified in making the most of. His interests and those of the public are diametrically opposite, as he obtains the greatest profit by charging the highest *paying* price. He is under but little responsibility to the legislature; he is not bound to study the comfort or convenience of the public; nor does he any more than suits his own purpose. In some cases his speculation has turned out good, and pays him from 5 to 15 per cent. per annum on his invested capital; in others it has been bad, and pays him little or nothing. But in either case, indiscriminately, he keeps constantly in view the one object, the greatest possible gain; and raises his fares with as little scruple on the one railway, which is paying him 15 per cent., as he would on the other, which may not be paying him five.

"The old channels of communication throughout the country have thus been superseded, and to the capitalist has been granted a monopoly of the new; a monopoly the most secure, as nothing can compete with it—the most extensive, as it stretches out on every side over the whole face of the land—the most lasting, as its holders possess it in perpetuity,—and the most injurious that can be conceived to the public good, as it places the community in the power of the individual capitalist on one of its most important matters.

"The railway system established in Belgium, and adopted by other continental countries, presents a striking contrast to that which I have just described. There the railways have been constructed entirely by government; the end aimed at has not been the gain of the individual, but 'the extension of the traffic and communications of the country to the utmost limits of the public capability, at the lowest rate of charge at which the original outlay can be reimbursed.'—'The project undertaken by government is an establishment which should neither be a burthen nor a source of revenue, and requiring merely that it should cover its own expenses, consisting of the charge for maintenance and repairs, with a further sum for the interest and gradual redemption of the invested capital.'*

"Such are the two different systems established in England and Belgium; and the manner in which each works is in exact conformity with the opposite principles on which they are based. The avowed object of the one is, to tax the public the maximum of the most profitable rate; that of the other, the minimum of the most economical expenditure;—the one to produce the greatest profit to private individuals, and the other to confer the greatest benefit on the whole community. What are the relative charges by each?

"On one of our railways, from London to Birmingham, for instance, the distance is 112 miles, and the fare by the mail is 1*l.* 12*s.* 6*d.*

"For the same distance in Belgium, in a similar class carriage, the fare would be 14 francs, or just *one third* of what it is in England.

"Would not this simple fact suggest to the mind of every one, that there must be something radically wrong in our system; that the existence of such a power, that of taxing the public *ad libitum*, placed in the hands of irresponsible individuals, carried on for the mere purpose of private gain, is an evil of the greatest magnitude? A monopoly of this extent should only be entrusted to government; or if granted to individuals, on such conditions that the public would not be deprived of the benefit they are calculated to yield as a great means for developing the industry wealth, enterprise, and resources of the nation.

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* Report of the Belgian Minister of Finance, 1836.

"The principle which is almost universally acted upon in this country, of leaving every undertaking to individual enterprise, is undoubtedly good; but like most other good principles may be carried too far—to such an extent as to be productive of great evil. It is certainly only where the public good imperatively demands it that the state is justified in becoming trader itself, or interfering between capital and labour as they are developed through the ordinary channels. With us it is only in such cases, or under very peculiar circumstances, that the state so interferes; such as the erection of lighthouses, beacons, harbours, public roads in some places, and works of a similar kind, which the capitalist would not undertake, as the return would be inadequate for his outlay. Again, the state trades between many ports by means of ships of war and packets carrying passengers and specie, but the principal direct traffic which the state carries on is in the conveyance of letters, a branch of trade it has converted into a monopoly beneficial to all parties. How far the public interests would have been served by the state making a monopoly of the conveyance of passengers for itself, as in Belgium, instead of granting that monopoly to others, the respective charges in the two countries will show.

But railway companies not merely refuse to recognize any obligation on their part to consult the public good, but break through, without compunction, the restrictions imposed by Parliament as a check upon their proceedings, and charge considerably higher rates than they have any right to impose. Indeed it appears to be the policy of every company to endeavour to hit upon that rate of fare which will make its profits the most, and that rate is in almost all cases a high one. But here again we must make room for the superior statement of the work before us.

"High fares must ever be the result of the present system, that is to say, *high compared with the cost of transmission*; for however low the latter may be, it does not in the slightest degree affect the charges made to the public. The only point of consideration with the Directors is to fix the fares at that rate which will produce the greatest profit to the shareholders; and accordingly they adapt the sliding scale within certain limits, moving up and down until they either have or conceive they have hit the exact point that will best pay without any reference whatever to the wants or wishes of the public. The Grand Junction lately, though paying 10 per cent. on its capital, raised its fares 27 per cent.; the Company may, perhaps, gain *one per cent.* by the advance; even that is doubtful, but supposing such to be the case, what a loss and inconvenience the public are put to for the attainment of such a comparatively paltry result. The Company gain but the twenty-seventh part of that which they are enabled to take from the community. To one class there is the annoyance of being obliged to forego their journey entirely or make it in an inconvenient manner, and on the other class is laid a direct tax of 27 per cent. in addition to the previous charge.

"Here, then, is illustrated the great evil of the present system: *the interests of the public are never for a moment considered by railway proprietors.* They will tax the public 30 per cent, though there should be but one per cent. gain to themselves, and it is only when they find that they have carried their principle too far that they think of retracing their steps.

In all the railways, without any exception that we are aware of, the accommodation of the poorer classes of passengers has been utterly disregarded; and indeed it appears to have been a study with most of these humane directories, to throw every difficulty, danger, and privation, upon those who could not afford an expensive mode of conveyance. On the Great Western Railway, in particular, this scandalous system has been carried to a most cruel pitch, and by every possible expedient of terror and annoyance the directors have sought to empty the third class carriages, in order that they might fill the first. To this end the third class carriages have been placed next to the engine, so that passengers might be terrified by the noise of the steam and the apprehensions of fire and explosion in the event of concussion. They are also kept sixteen hours on a journey which the mail-train accomplishes in six, and are obliged to start at most unreasonable hours, and subjected to every possible indignity. Upon other lines of railway the same spirit prevails, and if not quite so malignant, is potent and assiduous. On the Grand Junction Railway, for example, there are only two second class trains in the day, the first at the inconvenient hour of six in the morning, and the other at such a late hour in the afternoon, that it is impossible to get on from Birmingham to London the same night, except by taking a first class place, or travelling all night in an open carriage. The second train passenger again, who leaves London in the morning, in the hope of getting on to Liverpool direct, finds that on his arrival at Birmingham, unless he either takes a first class place, or waits the whole day in Birmingham, he cannot proceed. All these artifices for picking the pocket of the poor man are discreditable, unfeeling, and ought to be put down; and there is nothing of which we are more thoroughly convinced than that railway directories have rung their own knell by the avarice and tyranny of which they stand convicted.

There is much biting irony in the following:—

"But are railway companies to be blamed for charging the highest prices they can obtain, and using every fair means in their power to advance their own interests without reference to others? Most assuredly they have a perfect right to do so. If they consider, for instance, that they gain more by carrying 20,000 persons at a high rate than 100,000 at a low rate, they are perfectly justified in preventing the 80,000 from travelling on the railway who otherwise would. The profit in the one case might have been 5 per cent., and in the other 4½, and he would be a good patriot now-a-days who would sacrifice a half per cent. on the altar of his country! It would be considered a dereliction of duty on the part of the directors of a company so situated to prefer the good of the public to that of their own constituents; and indeed, to do the directors justice, any charge of neglect of that nature would be exceedingly groundless.

The translation of this ingenious passage is to be found in another page, and is as follows:—

"But is it not monstrous that in a country like this, boasting of the freedom of its institutions, and the responsibility which there is attached to the administration of power in every department of the state at home or abroad, foreign, colonial, national, and even parochial, that places in this respect the first minister of the crown on the same footing as the parish beadle; is it not, I say, monstrous, that two or three score of self-elected bodies, responsible only to their shareholders, should be possessed of the power to tax the public *ad libitum*, and who only stop in increasing their demands, when they arrive at that point where it ceases to be profitable,—whose *duty* to their constituents requires them to do so,—to extract every possible shilling in every possible way, however ruinous such a course is to the best interests of the nation, and the traveller is compelled literally, it might almost be said, to run the gauntlet over 1,700 miles of railway, the property of 50 different parties, subject to all the caprices and whims, the laws, bye-laws, regulations, and charges, which 50 times from 12 to 24 respectable elderly gentlemen think proper for their own good to subject them to?

It is impossible, however, for us to notice half the delinquencies of railway-boards that are here brought forward: we must content ourselves with the following summary of the several points of the case, every one of which are established upon evidence, which in our eyes is irresistible.

"1st. A discovery has been made of a means of transit which supersedes every other.

"2nd. A monopoly of it has been granted to a body of individuals in a great measure irresponsible to the state for the manner in which it is used.

"3rd. The relation between the public and the railway proprietors, is that of buyer and seller; their interests are consequently opposite, that of the one being to pay as *little*, that of the other to obtain as *much* as possible.

"4th. The monopoly being exercised only with the view to profit those who possess it, the general good of the community is entirely disregarded, and high charges having been found more profitable than low charges, the former have been adopted.

"5th. From this fact being established, the entire community, but especially the mercantile and humble classes, are put to great inconvenience and suffer a heavy loss.

"6th. The government cannot interfere to the prejudice of railway proprietors without granting them compensation.

"7th. The possession of this monopoly is, in the majority of cases, as unproductive to its owners as the manner in which it is exercised is prejudicial to the public."

These, then, are the main points of the case, and how are the evils which have left such deep and manifold traces of their bitterness to be remedied? Simply by the resumption on the part of the government of the powers it has delegated to railway directories, and of which they have made so injurious a use. The whole railways of the kingdom should be put either under some such officer as the Postmaster General, or under a board similarly constituted to the Board of Excise. The government would thus, in fact, become the purchasers of the whole railway property in the kingdom at a fair valuation; and then, and not till then, we may hope to have such a reduction in the fares as will put England, in this respect, on a par with other countries, and achieve the full development of the railway system. Such is the plan of railway reform unfolded in the work before us with singular force of argument and fulness of illustration. By some it will be objected that the benefits of such a scheme would be wholly fictitious, inasmuch as cheap fares would not pay the government if they would not pay private adventurers, and that the deficiency would have to be made up by tax, which would leave the public no gainers; for instead of having then to pay in the shape of railway fares, they would only have to pay the same amount as something else. There is more plausibility than weight in this objection, and we think we shall have no difficulty in showing that it is wholly unfounded. And we would first recall attention to the fact that in many instances railway companies have increased their fares twenty-seven per cent. in order to realize a profit of one per cent., the twenty-six per cent. being dissipated by the diminution in the traffic. Now, in this case, the public would be manifestly twenty-six per cent. gainers by paying the original low fares, and paying the one per cent. in some other way; in other words the public would be great gainers by cheapening the railway fares, and allowing the imposition of a small tax to make up the deficiency. We do not, however, believe that the imposition of any tax would be necessary, as the savings which might be realized and the advantages secured by the system of government management would, we believe, more than make up for the loss occasioned by the low fares. One great source of economy would be the abolition of the cumbrous and expensive machinery of directories, and the substitution of one efficient court of management and control, which should comprise all the railways in the kingdom. Another source of saving would be, in the different complexion railway property would assume by its connexion with the state, and the lower rate of dividend which would be equivalent to the dividends paid under the present system. Three per cent. in the funds is equivalent to 5 per cent. in a railway, the security and stability of the former mode of investment being a set-off against the fluctuations and insecurity of the latter. By coupling the railways with the state, and thereby giving them all the firmness of government securities, the dividend might be lowered without injustice to the shareholders. Then again, many railways are labouring under the weight of debentures, on which they are obliged to pay a very heavy interest, generally not less than six per cent., whereas if the railways were in the hands of the government the money might be had for three. Taking into account these and other sources of saving we might mention, we do believe that by putting the railways into the hands of government the fares might be reduced to one-third of their present amount without giving rise to any falling off in the revenue; and the poorer classes of the community would then enjoy the blessing of cheap travelling without any of the annoyance and indignities to which they have hitherto been so studiously subjected.

Our space prevents us from saying anything of the advantage of this reform in the railways, in connexion with the recent reforms in the post-office, to the full efficacy of which it appears to be essential. Nor can we stop to enumerate the numberless advantages, in the transmission of paupers, and a thousand other ways, of which the system would be productive. For these and other interesting details, we refer the reader to the work before us, where they will find them minutely and perspicuously stated, and they must be untractable indeed, if they do not rise converts to the views the writer advocates.

We cannot dismiss this work without expressing our regret that it has come before us so late in the month, as to have disenabled us to give it that full consideration to which it is so eminently entitled. Our examination of it, however, has been sufficiently extended to assure us that it is a work of extraordinary research and ability, and one which must create much sensation in the locomotive world. Of that sensation, we shall watch the tendencies, and we shall return to the subject, should our feeble advocacy appear of any avail, in shaking the impediments by which every measure of useful reform must be obstructed, or in refuting the arguments by which this, in common with every other abuse, will seek to maintain its ground.

Art. XIII.—NEW APPLICATION OF ELECTRO-METALLURGY.

In our last Number we detailed at some length the nature of the art of plating metals by the agency of electricity. Since then a new application of the art has come under our notice, which consists in the depositure of the metallic coating on the surfaces of fruits and flowers, by which means metallic representations of those objects of surpassing delicacy are obtainable. Several beautiful specimens of metallic flowers, obtained in this way by Messrs. Elkington, were exhibited at a meeting of the Horticultural Society, and excited much astonishment and admiration. The most delicate fibres and veins of the natural objects are presented in the metal coating with extraordinary fidelity, and the articles appear as if, by some spell more potent than that of Medusa, they had been suddenly transformed from vegetable flesh and blood into metal.

We ought to have explained, that the natural object, in every case, remains in all its integrity, but is encrusted with a metallic coating, by which it is hermetically sealed up, and its decay, in consequence, prevented. Artificial flowers, for ladies' head-dresses, as well as for a variety of other purposes, of great beauty, may thus be obtained. In fact, the number of uses to which the art may be extended is infinite.

Art. XIV.—THE POLYTECHNIC INSTITUTION.

We have had a very jealous eye upon this institution for some time past, in consequence of certain announcements relative to Flying exhibitions which have from time to time attracted our attention, and which we conceived were intended as an expedient for catching visitors, though obviously at the expense of the institution's reputation. It was our impression,—and an impression, we may add, which the flying advertisements appear calculated to create,—that certain tricks were resorted to for pandering to the public appetite upon this subject, and heightening the popular delusion—some automatum, perhaps, for flying about the room by cabalistic agency, or some other *coup de theatre*, equally contemptible and disingenuous. Our purpose for going to the institution was chiefly to see if these things were, and to denounce and expose them if they existed, as highly derogatory to science, and fatal to the character of any scientific establishment. The result of our visit has been to undeceive us, as to the nature of the flying exhibition, and take away, so far as the exhibition itself is concerned, all ground of dissatisfaction. We are still, however, disposed to find fault with the advertisements, as tending to bring the institution into discredit with respectable persons, and we certainly think they ought to be discontinued. Had our function not required us to go and judge for ourselves, we should have rested in the belief that some pitiful stage trick was being daily practised at the Polytechnic, to excite the wonder of the groundlings, and should have looked upon the institution and all connected with it as parodists of science, and sordid ministers to a popular delusion.

We shall, however, now say something of the various novelties that came under our notice; and first in the number is a steam printing press, and a cotton carding and spinning-machine, both of them additions since our last visit, and both highly eligible apparatus. The illustration of the method of accomplishing explosions of gunpowder under water is extremely interesting and appropriate, and appears to be excellently well managed. It consists in placing a wooden faggot, shaped like a ship, at the bottom of the great well, in which the diving bell descends, and blowing the faggot asunder by gunpowder ignited either by a fuse or by the electric fluid. The whole of the experiments made when we were present passed off admirably: the explosion being under water was attended by no noise, but a slight tremor was felt, and the smoke of the ignited gunpowder, and pieces of the faggot then immediately ascended to the surface.

The lecture on flying pleased and astonished us. The lecturer began by adverting to the multiplicity of schemes for achieving the navigation of the atmosphere that had been brought forward at different epochs, and pointed out the identity between some of the modern schemes and some of those which had been exploded for ages. He then went on to say, that the difficulty to be overcome in aerial voyaging, was not in obtaining a sufficient resistance in the air to buoy up a body by impulsion, or a sufficient power to accomplish that impulsion with the requisite force, but in obtaining a sufficient power with a sufficient lightness, without which it would be impossible to ascend, or at least to continue up. His line of argument, indeed, here was identical with that used by us when the flying schemes were first brought forward, and it is therefore unnecessary in us to notice it further. The lecture was altogether very clear, very clever, and very sound, and the sentiment expressed by the lecturer, of his abhorrence of any attempt to impose upon popular credulity by a mechanical juggle, or to pull down science from her throne, and make her the slave of pecuniary traffic, did equal credit to his heart and head. We trust it is by such sentiments that the directors of this institution will always be animated, for they are the only sentiments consistent not merely with science, but consistent with success.

Art. XV.—EMIGRATION.

The Cape of Good Hope and the Eastern Province of Algoa Bay. By John Centlivres Chase, Esq., edited by Mr. Joseph S. Christophers. London: Pelham Richardson. 1843.

We are not, in the abstract, disposed to recommend emigration as a principal remedy for the miseries which press upon the working population of these islands. The whole of the population might, we are confident, obtain full employment at home, if the restrictions which weigh upon our commerce were removed; but pending that consummation, emigration is one of the most obvious expedients for mitigating the existing distress, and lightening the burdens of the country. It is an object of the last importance to the emigrant to make a judicious selection, in fixing upon the land which is to be his future home; and as the question nearly concerns the class for which our pages are intended, we shall say a few words on the claims of the locality to which this work relates; believing, as we do, that they have not sufficiently attracted the public attention.

The Cape of Good Hope is, as every one knows, situated at the southern extremity of Africa. It belonged to the Dutch from 1562 to 1806, when it came into the possession of the English. The capital of the colony contains a population of 28,000; and the districts of Algoa Bay and Albany, colonized in 1820 by 3,800 emigrants, are now populous and flourishing. The climate is temperate, and well adapted to the English constitution; the soil productive, and the land cheap. Upon these heads, however, it will be better if we give the reader the statement of the work before us:—

"In 1821, the exports of Algoa Bay were 1,500*l.* In 1841, without any increase of population by emigration, the exports were 71,242*l.*; and from the rapid increase in the export of wool and other articles, the produce of the colony, the first half-year's exports of Algoa Bay, for 1842, were 75,804*l.* sterling. In 1820 three huts adorned the beach of Algoa Bay; Elizabeth Town now numbers 3,000 souls. In 1820, Graham's Town, in Albany, about 100 miles up the country, was not more populous than Elizabeth Town then; it now has a population of nearly 6,000 people, principally English. Utenhay, about 18 miles from Algoa Bay, contains about 2,000 souls. Besides these, there are numerous towns and villages decking the country, such as Somerset, Graf Reynet, Beaufort, Bathurst, Sidbury, Salem, Cradock, &c. &c. The total population of this province is about 70,000, making a progress equal to, or surpassing that of, any other colony. In the growth of wool it increases ten times as fast as Australia; and the staple itself quite equal, having been sold at 2*s.* 6*d.* per lb. Land, of equal value, may be purchased at a quarter the price of Australian land. Wages quite as high, say for mechanics, from 4*s.* 6*d.* to 7*s.* 6*d.* and even 9*s.* a day. Farm labourers, 25*s.* to 40*s.* per month; and shepherds from 25*l.* to 45*l.* per annum, besides board and lodging. Beef and mutton, $1\frac{1}{2}$*d.* to 3*d.* per lb. The climate more healthy than England, or any colony. The deaths in England are 14 per 1,000 per annum; in Canada and Australia (both considered very healthy), 16 per 1,000; but in Algoa Bay only $9\frac{3}{4}$. It is warmer than Canada, nearly as warm as Australia. Bread is rather dear; labour being high, the quartern loaf is commonly 12*d.*; it should be cheaper than in any other country. The wheat is the finest in the world, without any exception; heavier by three or four pounds the bushel than the best English; and always fetching, in the corn-markets of London, Calcutta, Mauritius, and Australia, more than any English or foreign grain. The population of the whole colony is about 200,000; the county of George alone could sustain five times that number; and the whole colony, well governed, would support at least 8,000,000 of people, in prosperous circumstances. Convicts have never been introduced; and, in proportion, more churches and chapels exist than in any colony, consequently morality generally prevails. The proportion between the sexes in Australia is as 55,000 males to 21,557 females; Van Diemen's Land, 29,044 males to 12,027 females; at the Cape, in 1839, the proportion was nearly the same as in England, 72,485 males to 71,856 females. In almost every town and village, Government free schools, even patterns to the mother country, are generally established; and, in short, the colony may be considered, and is, eminently prosperous, moral, and intelligent; and all that is wanted to give it quite the lead amongst the colonies of England, is the emigration of the useful mechanical trades, field labourers, and shepherds. The latter are usually allowed to accumulate flocks of their own.

"One emigrant writes from Algoa Bay,—'All Lancashire could come here, and fare well.' Not so exactly; but 5,000 farm labourers and shepherds should annually go; and about 500 mechanics, consisting of bricklayers, stone-masons, and plasterers, carpenters, bakers, butchers, shoemakers, tailors, saddlers, harness-makers, wheelwrights, turners, cabinet-makers, smiths, painters, glaziers. A few coppersmiths and braziers, cutlers, and printers, would also get business. Domestic servants wanted by almost every family. Also, some respectable governesses, without high notions, yet with good qualifications. But few tradesmen or shopkeepers should go. Clerks are not wanted, nor young men assisting behind the counter; nor goldsmiths, silversmiths, ivory-workers, dancing-masters, nor refined manufacturing artizans. The Cape wants no useless or fanciful characters. Idle and intemperate people should stay at home. The industrious and sober not only obtain comfort, but acquire independence."

We do not say that there may not be a little over-painting in these pictures,—and, to say the truth, we are inclined to think there is; nevertheless we believe them to be, in the main, true representations, though brightened or clouded, perhaps, a little too much, by the hand of a well-meaning advocate. One great advantage of the Cape colony is, that it is not a new and barbarous place, where emigrants run the risk of being starved or frozen, before they have time to raise food, or construct houses for shelter. Upon the whole, it appears to us that the Cape colony possesses advantages for emigrants over any other with which we are acquainted.

Art. XVI.—MARKLAND ON CHURCHES.

Remarks on English Churches, and on the Expediency of rendering Sepulchral Memorials subservient to pious and Christian Uses. By J. H. Markland, F.R.S. and S.A. Third edition. Oxford: Parker, 1843.

This is another of those pious architectural works of which the present age has produced so abundant a crop, and which all appear to have one fundamental tenet, viz., that the Gothic is the only style of architecture suitable for churches; and that the preference of any other can only proceed either from a want of Christian principle, or from deplorable ignorance and stupidity. Most of these works have emanated from the Oxford manufactories, and bear indelible traces of the emptiness and self-sufficiency which might be expected of the monks of the aristocracy. We should be disposed to wage war upon these gentry, if they had sufficient pith in them to prevent the contest from degenerating into an ignoble one. As it is, we must let them pass. We should have as much compunction in molesting these *architects* as our sailors had in slaughtering the Chinese.

Art. XVII.—THE LAW OF PATENTS.

The Inventor's Manual: a familiar and practical Treatise on the Law of Patents for Inventions. By J. Towne Danson, and G. Drysdale Dempsey. London: Weale. 1843.

The importance of the law of patents is not yet adequately appreciated in this country. To us it appears that it lies at the root of our national prosperity, and that in proportion as it is wisely or unwisely administered, must our greatness brighten or wax dim. No man will take the trouble to invent, if he may not derive some advantage from his invention,—a point which the law of patents determines; and if invention be once repressed, we must become a stationary nation, like the Chinese,—if, indeed, we do not advance with rapid strides to ruin and barbarity. Nor is it much to the purpose that there is a law of patents, if the administration of that law is such as to render it inert; and it cannot be denied that the administration of the law in this country has in a multitude of cases been such as to operate as a serious discouragement to invention. To this point we shall for the future more carefully look.

It is very important to all inventors that they should have a sound general conception of the patent law, and this the work before us is calculated to give them. It is judiciously compiled and very well written, and appears calculated completely to fulfil the purpose for which it was intended.

Art. XVIII.—MANUFACTURE OF IRON.

Experiments upon Cast and Malleable Iron, at the Milton Iron Works, Yorkshire. By David Mushet. London: Clowes and Sons. 1843.

These experiments are of much interest, and appear to have been conducted with care and skill. They go to overset the popular notion, that hot blast iron is weaker than cold blast, and are indeed favourable to the belief that the hot blast is the stronger of the two. They further show, that the cohesive strength of cast iron is not in the proportion of its specific gravity, while its elasticity and power to resist impulsion appear to become greater just in the proportion its specific gravity becomes less. It would also appear, from these experiments, that the strongest qualities of iron are numbers three and four, and that iron re-melted in an air furnace is considerably stronger than if re-melted in a cupola.

Art. XIX.—INDIAN RUBBER PAVEMENT.

Advantages of the Patent Elastic Caoutchouc Pavement, as used for Stables, &c.: with its adaptation as a Floor-cloth. London: Grove and Sons. 1843.

Although we have long been sensible of the versatility of Indian-rubber, we never, even in our most abstracted moods, contemplated the feasibility of its adaptation to the purposes of paving. Here, however, we have it not merely in the shape of paving-blocks, but in that of planks for boat-building, and ship-linings to prevent splintering from cannon-shot. Truly these things would appear visionary, had we not the evidence of competent and respectable witnesses that the several applications of this material perfectly fulfil their intended uses.

We ought to observe, that we have not ourselves seen any specimens of these several varieties of Indian-rubber compound, and cannot speak, of our own knowledge, of its qualities or efficacy. It appears, however, from the pampblet before us, that the paving has been applied in stables and other places with every success. In the stables of Sir Francis Collier, at Woolwich, the plan has been for a considerable time in use; and from what Sir Francis Collier says, it appears to have given every satisfaction.

Art. XX.—COLES' RAILWAY WAGONS.

Some of Mr. Coles' railway schemes are, we fear, a little Utopian. His method, however, of lessening friction in railway axles, by the application of friction, or more properly, perhaps, *anti*-friction wheels, we are disposed to except from this judgment. Whatever be its merits at least, the plan has certainly not yet received adequate consideration from engineers; and with the view of bringing it more immediately under their attention, we think it right to state the effect of the application.

Mr. Coles, we should state, has a model of a carriage, to which the wheels are so fitted, that they can be made to operate either on the common or anti-friction principle. This carriage weighs 12 lbs., and, with the wheels on the common principle, requires a weight of 3 ozs., acting over a pulley, to draw it on an iron plane. With 2 lbs. of additional weight, the tractive force required is 4 ozs., and with 140 lbs. weight, 40 ozs. With the wheels put upon the anti-friction plan, the tractive force requisite for drawing the carriage with 140 lbs. weight is only 4 ozs. This experiment we saw fairly repeated several times with the same results.

Art. XXI.—THE SOCIETIES.

The Royal Society.—This Society adjourned for the season at their last sitting. On that occasion several papers were read, but none possessed much novelty, excepting one from R. Bigg, Esq., on the growth of plants. Mr. Bigg is of opinion that the substances carbon and nitrogen, which have hitherto been considered elementary, are in fact compounds, and that they are actually made by plants during their growth. In his experiments sprigs of mint were placed in water without communication with the atmosphere, yet they grew within a few weeks to more than double their former size; their chemical constituents being increased in weight in like proportion. He infers from this, that as the sprigs of mint had no access to carbon or nitrogen, the accretion of those substances in the plant could only have taken place by their composition from the elements of water.

The Microscopical Society.—The examination of nature in her minutest works is calculated to afford important insight into ultimate causes of her operations. A society, therefore, having this object especially in view was much wanted. The Microscopic Society has been founded about three years, and it has proceeded steadily to accumulate facts, and to extend observations into the minutest details of creation. At the meeting of the Society on the 21st of June, a paper was read from Mr. W. Addison, of Great Malvern, on the colourless corpuscles of the blood, and on the change that fluid undergoes during inflammatory disease. He observed, that the colourless corpuscles, when subjected to pressure, retain their circular outline, and are harder and firmer than the red globules. When a drop of blood, taken from an inflamed surface, is examined, the colourless corpuscles are found to be much more numerous than in healthy blood. Mr. Addison is of opinion that all animal membranes and tissues are formed by the accretion of these colourless corpuscles alone.

Cornwall Polytechnic Society.—We noticed in our last Number the important discovery, by Mr. Bain, that a plate of zinc and a plate of copper buried in the ground, and connected by an external wire, form an ever-acting terrestrial voltaic battery. It now appears that a series of experiments have been prosecuted in the Pennance copper-mine, near Falmouth, for the purpose of developing electricity from the veins of metallic ore contained in the bowels of the earth. At a recent meeting of the Cornwall Polytechnic Society, the results of these researches were communicated by Mr. Were Fox. On connecting, by means of wires, veins of copper with veins of iron pyrites, situated from fourteen to eighteen fathoms asunder, sufficient electricity was developed not only to deflect the needle of the galvanometer, but to decompose solutions of metallic oxides, and to complete the electrotyping process. Thus it appears there exists a natural voltaic battery in the earth capable of producing most powerful effects when called into action.

French Academy of Sciences.—The learned academicians of the French Institute have sometimes under consideration propositions that might be laughed at by the veriest infant in science. On the 19th of June a M. Delpon proposed a plan for preventing earthquakes, by boring numbers of Artesian wells, which he supposed would act as vent-holes for the internal force! Putting aside the absurdity of imagining that the crust of the globe can be pricked through like a biscuit for the escape of pent-up vapour, it ought to have been known, even to this philosopher, that Artesian wells are bored only into the outermost of the earth's coatings, and that if he wanted to penetrate to the interior he should have proposed to drill a hole into the foundation granite, which appears on the peak of Mont Blanc, and so convert it into a safety chimney for the escape of noxious gases.—On the 26th of June M. Masson read a memoir on a mode of obtaining fixed images of objects by means of electricity. The objects operated on were medals. These he placed on a metal plate, coated with a thin layer of resin, and covered with fine loose powder. When the medal so situated is connected with the positive pole of a voltaic battery, the powder arranges itself on the resinous plate in a manner corresponding to the relief of the medal, and forms what M. Masson terms a positive image. If the medal be connected with the negative pole, the powder is repelled from the prominent parts, and forms a negative image. By gently heating the resin the powder adheres, and the image of the medal becomes fixed.—M. Bory St. Vincent presented a report of the results of his scientific mission to Algeria. It appears from his account of the capabilities of the soil and climate of Africa, that it can produce grapes equal to those of Spain and Madeira, the finest tobacco in the universe, cotton superior to that of America, olive oil, silk as abundantly as China, and fruits of every description. The climate is said to be milder in winter and less hot in summer, excepting during the siroccos, than the south of France. Altogether, M. Bory St. Vincent represents the French colony in Africa to be a perfect paradise. — On the 11th ult. M. Boussingault read a report from the committee appointed to examine a new disinfecting powder discovered by M. Siroy. A small quantity of this powder, it is said, disinfects immediately the most putrid animal matter. Its composition is a mixture of pulverised charcoal and sulphate of iron. The effluvium arising from putrid animal matter consists of ammonia and sulphuretted hydrogen, and the powder acts by absorbing part of the sulphuretted hydrogen by means of the charcoal, and it absorbs the ammonia by the sulphuric acid of the metallic sulphate.—Messrs. Choiselat and Retel communicated a new theory of the phenomena of the Daguerreotype. They conceive that the iodide of silver, by the action of the light, is transformed into a sub-iodide. That this sub-iodide, when in contact with the proto-iodide of mercury, forms red iodide and metallic mercury; and that the metallic mercury coming into contact with the iodide of silver is changed into proto-iodide, and the silver is disengaged. The lights of the Daguerreotype image are formed, according to this theory, by particles of the amalgam of silver deposited on the surface of the plate, and the shadows by the polished surface of the metal and particles of silver and of mercury.

ART. XXII.—INVENTIONS OF THE MONTH.

Self-regulating Voltaic Battery.—It has long been a desideratum to obtain a galvanic battery of equably sustained power, especially since the invention of electrotyping; for on the nice adjustment of the quantity of electricity to the surface on which the metal is to be deposited, the success of the operation greatly depends. Daniel's constant battery was an important improvement on all preceding voltaic arrangements for this purpose, but even that is liable to vary in its action after some hours, and batteries of different size are required for larger and for small operations. To remedy these inconveniencies, Mr. Bain, (the ingenious artizan, whose discovery in electricity and the application of it to the electro-magnetic printing telegraph was noticed in our last Number,) has contrived an apparatus which be can adjust so as to obtain from any battery of sufficient magnitude the exact quantity of electricity required, and to ensure its equable action for days in succession. The voltaic battery itself is an ordinary one, consisting of one or more earthenware troughs, into which zinc and platinized-silver plates can be immersed at pleasure. In Mr. Bain's apparatus the metal plates are suspended over the troughs by a string, which is attached to clock-work, the plates acting as the weight. When this clock-work is in action, the string turns the fuse round which it is twisted, and the plates drop gradually by their own weight into the earthenware troughs which contain the acidulated water. As soon as the zinc and silver plates touch the liquid, voltaic action commences, and a small electro-magnet connected with them becomes instantly attractive. This magnet acts upon a piece of soft iron attached to a spring, and when the magnetic attraction is sufficient to overcome the force of the spring, the iron is drawn to the magnet, and a stop is thereby put to the motion of the wheels. When the energy of the action diminishes, the spring overcomes the attractive force of the electro-magnet, and returns to its former position. The stop is thereby withdrawn, the wheels resume their motion, and the plates of metal descending a little lower into the acidulated water, the electrical energy is renewed, and the magnet acts as before in stopping the further motion. In this manner the quantity of electricity evolved from the metal plates is maintained constantly the same, until they reach the bottom of the trough. To regulate the amount of power it is only requisite to adjust the electro-magnet nearer to or farther from the spring. When it is near, the wheels are stopped by a smaller amount of electro-magnetic attraction; where further apart, it requires more electric force to communicate sufficient power to the magnet to attract the spring and stop the motion.

Self-acting Soda-water Apparatus.—An apparatus for manufacturing soda-water, on a principle very different from that of the machines hitherto constructed, has been recently brought out by Messrs. Knight and Sons, of Foster-lane. The interior part of the apparatus consists of an earthenware cylinder, about twenty-one inches long by seven inches diameter; which is divided, by a strong partition, into two compartments. In the lower compartment the carbonic acid gas is generated; the upper one contains the water, or other liquid, to be aerated. The gas is generated from sesqui-carbonate of soda and diluted sulphuric acid, the sulphuric acid being kept apart, in a small cistern, in the lower compartment. The earthenware cylinder is inclosed in a strong iron case, to which two pivots are soldered, whereby the whole apparatus is suspended on a cast-iron stand, so as to be easily vibrated backwards and forwards. At each vibration a small quantity of the sulphuric acid is thrown out of the cistern, among the sesqui-carbonate of soda, and carbonic acid gas is immediately generated. The gas is forced, by its own pressure, through a series of tubes, which connect the generator with the upper compartment, into the liquid to be aerated; and, in about a quarter of an hour, the soda-water becomes thus impregnated with four or five atmospheres of gas. The vibration of the machine serves to agitate the water and to facilitate the impregnation, at the same time that it causes the gas to be generated. The proportions of soda and sulphuric acid are adjusted so as to neutralise each other, and to produce no more gas than is required for one charge.

Novel Application of Electrotype.—M. Becquerel has applied the oxides of metals to the surfaces of other metals, so as to produce beautiful effects; and to serve the purposes, both for use and ornament, of the deposition of the pure metals. He conceived that by applying the coloured unchangeable oxides, such as those of lead, to the surfaces of other metals, he should be able not only to cover them with a protecting metallic varnish, but to render the process capable of ornamental decoration. Some specimens of ornaments made from common metals, and thus coated, were exhibited to the Academy of Sciences on the 11th ult. Among them was a garland of leaves and fruit, the different parts of which were yellow, red, violet, and blue, according to the nature of the oxides deposited, and of the most brilliant colours. When the object is merely to coat the surface with a single oxide, it is only necessary to plunge the metal in an alkaline solution of the oxide, and attach it to the positive pole of a single pair of plates.

Glass a Substitute for Iron.—The *Courrier de Lyon* mentions that glass is being substituted in that neighbourhood for iron, in the manufacture of water-pipes. The glass pipes are covered with bitumen, and they are joined together by a cement of that substance. Pipes thus constructed are incorrodible, and nothing but a violent concussion can destroy them. They also possess the great advantage of superior purity, and freedom from metallic impregnation of the water.

Magnetic Anemometer.—The *Journal des Debats* publishes a letter from Rochefort, which mentions a new kind of anemometer recently invented there, that is said to indicate not merely the force of the wind at the time present, but to anticipate what the force of the wind will be some time afterwards. The description given of the apparatus is extremely vague; nor can we comprehend from it how the instrument operates. It is said to consist of a thin piece of wood, nicely balanced on a steel point; and into this wood are inserted perpendicularly three or four small magnets, made from straitened pieces of watch-spring. On these pieces of upright magnetic steel the wind impinges, and turns the vane; but by what means it can foretel a gust of wind, or how measure its force, the account in the French journals is too obscure to enable us to conjecture.

ART. XXIII.—ANALYSIS OF BOOKS.

A Tribute to Hydropathy. By J. E. EARDLEY WILMOT, Esq., Barrister-at-Law. London: W. J. Cleaver. 1843.

WE have some suspicion that this book is tinged with quackery, and that its end and aim is not so much to extol the advantages of hydropathy, as to proclaim the merits of a certain bath at Stansted-Bury. Of this, however, our readers shall judge; and they may take the following, where, it will be observed, terms, situation, and the other et ceteras are noted with the speciality of any advertisement which requests us to beware of counterfeits:—

"The institution at Stansted-Bury, which, I believe, was the first set up in this country for the votaries of hydropathy, is about 23 miles from London, on the North-Eastern Railway, and about four miles from the town of Ware. The Roydon station is within ten minutes' walk of the house, and this is pleasantly situated on a hill close to the little church of Stansted. The village is about a mile distant, that of Roydon rather less. The most important matter on arrival is the selection of an apartment. I was shown over many by the controller. They vary in price according to size, situation, and aspect. Some are as low as four guineas, and the best are, I believe, as high as eight or ten. These terms include board and medical attendance. For fires in the apartment the invalid pays five shillings per week extra. The only expenses not included in the weekly terms, besides fire, are a fee of four shillings per week to the bath attendant from gentlemen, and three shillings per week from ladies, and a small gratuity generally given (but this is quite optional) to the servants of the household on departure."

The following, too, is quite in the style of the bulletins which proclaim the virtues of Morison's pills:—

"A few months ago a near relative in orders, whom I had last seen before he left England for the Continent in search of health, called on me at my chambers in the Temple; and on my expressing my great astonishment at the improvement in his appearance, he replied that he had found in a spring of cold water, within thirty miles of London, the relief which he had bitherto tried every remedy to obtain at home and abroad without success. He had given a fair trial to several of the German baths; still his bodily debility and nervous sensations continued, precluding him altogether from the discharge of his arduous offices as a minister, when he accidentally met with a book on the Water Cure. As a last resource he visited Stansted-Bury, and in the course of a short time found his distressing symptoms alleviated, his strength increased, and, by strictly adhering to the rules laid down for him during the following winter, was enabled to undertake more duty than he had done for nearly two years. Although he spoke with great enthusiasm and confidence, I was at first incredulous, and could not understand how the application of wet bandages to the stomach, or the sitting in cold water for twenty minutes, could do otherwise than inflict severe injury upon the constitution.

"Soon after the visit of my relative, I was attacked myself by severe indisposition, arising from biliary derangement. For these bilious attacks, which returned so frequently as to render necessary my having constant recourse to powerful medicines, and to prevent any great or long-continued exertion of body or mind, I had consulted many eminent physicians both in England and abroad, but their prescriptions seldom varied much. Preparations of calomel and blue pill formed the principal ingredient in them. At the end of five weeks, finding myself no better, I determined at once to give up all medicine and try cold water. A careful perusal of Claridge's book, which was the only work on the subject within my reach, raised my hopes; and the recommendation of a friend, powerfully eloquent in its behalf, confirmed my decision; and soon afterwards, making a bonfire of my pill-boxes and prescriptions, I hastened to Stansted-Bury."

The introduction, however, to this little work is the most amusing part of it. Who ever before saw such a parody on Rasselas? It is irresistibly ludicrous, and at first led us to imagine that the whole thing was a burlesque:—

"Ye who have hitherto sought in vain to recover that invaluable blessing, thus beautifully appealed to by the Greek poet; too good friends of the chemist, who have spent much upon physicians, and yet grown worse; who no longer know that joyousness of heart and elasticity of spirits which gave to you the full enjoyment of life before languor overcame you; hearken to the grateful words of one, till very lately a fellow-sufferer with yourselves, but now, through the mercy of the Divine Physician, restored to health and strength by the simple agency of water. The hope that others may derive similar benefit from hydropathy, no less than the misconception generally existing on this subject in the minds of the people of England—which has rendered its progress less rapid here than in other parts of Europe—have induced me to publish in the following pages the result of my observations upon the treatment I underwent at Stansted-Bury, in Hertfordshire."

The Stansted baths, Mr. Wilmot informs us, belong to Dr. Graham, who, it seems, is willing to dispose of them; which may, perhaps, account for the eloquence of Mr. J. Eardley Wilmot, Barrister-at-Law, in their behalf. But, however that may be, we fear his zeal has outstepped his discretion, and that his recommendation will fail in its purpose, from the want of a few of those moderating shades which a skilful advocate would have given.

We do not, however, say anything against hydropathy itself, which we have no doubt is a very good thing in some cases. But the fault of the advocates of these new plans, which periodically spring up and disappear, is, that they urge them beyond their proper bounds, and will not be content unless their favourite nostrum be accepted as a specific for every malady. Thus far, however, we will go with Mr. Wilmot: in those cases where hydropathy is really useful, we do not see why that remedy may not be as effectually administered at Stansted as in Bohemia, Switzerland, or any other inaccessible region.

An Account of some remarkable Application of the Electric Fluid to the Useful Arts, by Mr. Alexander Bain; with a vindication of his claim to be the first inventor of the Electro-Magnetic Printing Telegraph, &c. By JOHN FINLAISON. London: Chapman and Hall. 1843.

A dispute has arisen between Mr. Bain and Professor Wheatstone, as to the merit of certain inventions in electrical apparatus, which each of them claims; and the purpose of this work is to set Mr. Bain's claims upon their true footing. We are unable this month to go into the question, but will do so as soon as we can; and no effort of ours shall be wanting to attach the merit wherever it may be due.

The Nature and Property of Soils. By JOHN MORTON. London: Ridgway. 1843.

We have been unable to complete our examination of this very useful work in time to give an account of its contents in our present number, but trust to be able to overtake the task in our next. From the few hasty glances we have had of the work, it appears deserving of a full investigation.

The Rhine: from the French of Victor Hugo. By D. M. AIRD. London: D. Aird. 1843.

THIS work could have only been written by a Frenchman; and to Frenchmen only is it likely to be completely acceptable. We do not say this on account of the violence of its nationality, which, we observe, is subdued as much as possible in this translation, but because of its sickly and exuberant sentiment and childish caprice. The lines of genius which run through it are, no doubt, conspicuous and indelible; but at the moment the blaze most dazzles us, we feel it to be merely phosphorescent and unsubstantial. In short, there is a want of manliness conspicuous throughout the work, which will limit its delight to English people, though perhaps a matter of indifference to the French. To our eyes Mr. Hugo appears very much like a simpleton of genius. But we suppose we must give an extract, and we select the following relative to Cologne and its cathedral:—

"The sun had set when we reached Cologne. I gave my luggage to a porter, with orders to carry it to an hotel at Duez, which is a little town on the opposite side of the Rhine, joined to Cologne by a bridge of boats; and then directed my steps towards the cathedral. Rather than ask my way, I wandered up and down the narrow streets, which night had all but obscured. At last I entered a gateway leading to a court, and came out on an open square,—dark and deserted. A magnificent spectale now presented itself. Before me, in the fantastic light of a *crépusculaire* sky, rose, in the midst of a group of low houses, an enormous black mass, studded with pinnacles and belfries. A little further was another, not quite so broad as the first, but higher; a kind of square fortress, flanked at its angles with four long detached towers, and having on its summit something resembling a huge feather. On approaching, I discovered that it was the cathedral of Cologne.

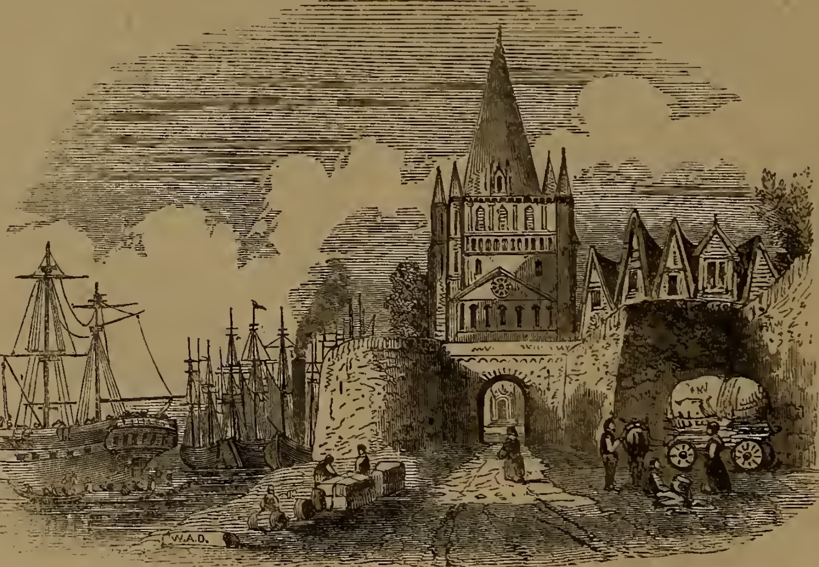
"What appeared like a large feather was a crane, to which sheets of lead were appended, and which, from its workable appearance, indicated to passers-by that this unfinished temple may one day be completed; that the trunk of a belfry and church, so widely apart at present, may ere long be united; that the dream of Engelbert de Berg, which was realized into an edifice under Conrad de Hochsteden, may, in an age or two, be the greatest cathedral in the world. This incomplete Iliad sees Homers in futurity.

"The church was shut. I surveyed the steeples, and was startled at their dimensions. What I had taken for towers are the projections of the buttresses. Though only the first story is completed, the building is already nearly as high as the towers of Notre Dame at Paris. Should the spire, according to the plan, be placed upon this monstrous trunk, Strasburg would be, comparatively speaking, small by its side. It has always struck me that nothing resembles ruins more than an unfinished edifice. Briers, saxifrages, and pellitories,—indeed, all weeds that root themselves in the crevices and at the base of old buildings,—have besieged these venerable walls. Man only constructs what Nature in time destroys.

"All was quiet; there was no one near to break the prevailing silence. I approached the façade, as near as the gate would permit me, and heard the countless shrubs gently rustling in the night breeze. A light which appeared at a neighbouring window cast its rays upon a group of exquisite statues,—angels and saints, reading or preaching, with a large open book before them. Admirable prologue for a church, which is nothing else than the *Word* made marble, brass, or stone! Swallows have fearlessly taken up their abode here, and their simple yet curious masonry contrasts strangely with the architecture of the building.

"This was my first visit to the cathedral of Cologne."

The work, we ought to add, appears to be excellently translated.



COLOGNE.

ART. XXIV.—MARVELS OF THE DAY.

The Euphonicon.—This is a new species of musical instrument of the pianoforte genus, but in appearance more resembling a harp than a piano. The purpose of the peculiar formation is to obtain a superior tone than can be realized in pianos of the ordinary kind, and the way in which the end is attained is as follows:—

A frame of cast iron of the requisite size and figure for containing the strings is erected perpendicularly, and to this frame the keys for striking the strings are attached, about one-half of the length of the strings being extended below the plane of the keys, and the remainder above. To the lower portion of the strings a series of five or six sounding-boards are adapted, each of the form of the body of a violoncello, and decreasing in size from the large strings to the small ones. Each sounding board receives about an octave of strings, and as none of the sounding-boards extend above the llevel of the keys, the upper portion of the strings are open as in a harp, and indeed the upper part of the instrument has very much of the harp appearance. Between the strings and the sounding-boards, bridges are interposed exactly on the same principle as those of the violoncello, without which the sounding-boards would not be productive of their proper efficacy.

From this outline of the plan, our readers will perceive that the whole strain of the strings is thrown upon the cast-iron frame, with the exception of that portion of strain cast by the bridges on the sounding-boards, which is altogether insignificant. In ordinary pianos, on the contrary, the whole strain of the strings, amounting to several tons, is cast upon the sounding-board, and the freedom of vibration in the particles of the wood is thereby much impeded the effect of which is to injure the tone. It is in this single peculiarity of the sounding-boards being relieved from strain, that the superiority of this instrument lies, and certainly it is one of no small importance. It not merely secures greater freedom of motion in the particles of the wood, but makes the application of sounding-boards of much greater delicacy practicable.

There are numerous collateral advantages of which the use of cast-iron is productive. The frame, for example, being less liable to shrink and warp than if made of wood, the instrument is less liable to get out of tune. The strength of the material too enables the frame to be made of great lightness and delicacy, and the instrument is consequently peculiarly elegant. Altogether this instrument is one of much beauty and perfection, and will, we are confident, if the price be not an impediment, speedily supersede pianos of every other kind.

There are various improvements in the detail of the instrument, which go to give it greater durability and completeness. The tightening of the strings is accomplished by means of screws, instead of by means of pegs driven into wood, and the pegs are arranged on a better principle than is commonly adopted. These, however, are improvements of which any kind of piano are susceptible, and, in some cases, they have, we believe, already been applied.

Architectural Class, London University.—The Course of Lectures on Architecture, at the University College of London, were completed on Thursday, the 15th of June, on which occasion the Professor accompanied his class to see some lime-kilns in the neighbourhood of London, the parts and uses of which he explained in detail, in illustration of lectures already delivered on the subject. The whole party afterwards proceeded to the Houses of Parliament, which were also examined, in company with Mr. Barry, who, with great kindness and affability very minutely pointed out every thing most remarkable and best deserving attention. The course for the session 1842-43, consisted of fifty-three lectures. On Friday, the 27th, the pupils entered the class-room for examination for honours. In class A (Architecture as a fine art) from 9 to 12 o'clock; in class B (Architecture as a science) from 1 to 4 o'clock, the following regulations were observed:—

A series of questions for the class was privately printed, and a copy delivered to the student after he came into the examination room.

The answers were written in the examination room, into which no book was allowed to be brought.

The paper containing the answers was signed with a number and the name of the student using it, inclosed in a sealed envelope, inscribed with the number which was left before the day of examination at the College, to be opened at the distribution of prizes.

Besides the prizes in each of the classes, certificates of honour were awarded to all who have attained in their answers a certain amount of excellence previously fixed. The same student might gain a prize or certificate in every class.

No student, who obtained a first prize in a former session, is allowed to contend for a prize in the same class in a subsequent session. And no student, who obtained a second prize in a former session, is entitled to receive a similar prize in the same class.

EXAMINATION.—SESSION 1842-43.

ARCHITECTURE AS A FINE ART. (Course A.) First Year.

Greek and Roman Architecture.

1. Into how many orders has architecture been classified by the Greeks, Romans, and modern Italians?
2. State the leading essential parts common to every order.
3. Make a sketch of the first rude building, showing the origin of the principal features of an order and temple.
4. Describe the distinctive features of each order.
5. How did the antæ differ from the pilasters, and to which people were these features peculiar?
6. Name the parts of a Corinthian capital.
7. Draw the spiral of an Ionic volute with its diagram.
8. Specify the general proportions of each order.
9. Name some edifices in Greece, Rome, and London, classified according to the orders.
10. State and define the classes of temples according to the arrangement of the plan.
11. Describe the styles of temples according to the intercolumniation.
12. Draw the plan of a peripteral hypæthral temple, and put the names to the several parts.
13. What were the propyla of ancient buildings, and their leading features? State examples.
14. Name and describe the principal parts of a Greek theatre, and give a rough sketch of the plan; note whether the circular part be a semicircle, or whether it be more or less than a semicircle.
15. With what people did triumphal arches originate? how many classes were there of them, and what the peculiar features?
16. Describe the uses and proportions of an agora and forum, and of the buildings connected therewith; note to what people each was peculiar.
17. Describe the Coliseum and thermæ or baths of the Romans.
18. Sketch a plan of a circus: state to what people peculiar, the uses of the parts, and the corresponding edifice with the other ancient people.
19. State the distinctive difference between Greek and Roman architecture.
20. What is the name of the classic writer on architecture? and at what period did he live?

Egyptian Architecture.

21. What are the earliest specimens of Egyptian architecture?
22. Describe the principal parts, the uses and decorations.
23. State the chief accompaniments of an Egyptian temple outside the peribolus; their arrangement, proportions and decorative embellishments.
24. Sketch the plan of an Egyptian temple, with its several precincts, courts and halls.
25. Make a sketch of a propylon with its decorative accompaniments.
26. What object in nature did the Egyptians adopt as the prototype of their capitals? Sketch, in their general proportions, two or three examples of shafts and capitals.
27. Draw a plan and section of a pyramid, showing its galleries and chambers.
28. Name the situations and dimensions of any of the principal pyramids.
29. Describe generally the peculiar character of Egyptian architecture.

FROM OUR OWN CORRESPONDENTS.

MANCHESTER.—*New Bridges.*—In addition to the new bridge, now erecting, to carry the short junction line of railway over the river Irwell, at Hants bank, (mentioned last month,) a new county bridge is also to be erected lower down over the same river, on the site of the New Bailey bridge, which is said to have been sometime in a dilapidated state, and is now being pulled down. The new bridge is to be completed within twelve months; it will be of stone, one arch and *askew.* The architect is Mr. G. W. Buck, Civil Engineer; the contractors, Messrs. Bowers and Murray, and the expense, including the removal of the old bridge, about £7500.

GLASGOW.—*Iron Steamers and Ships.*—We have just now had the gratification of hurriedly inspecting Mr. Robert Napier's new iron steam-ship, for the south of Ireland trade. We were struck with the more than usually substantial fabric of the shell, and the great strength of the lower framework. In the part occupied as engine and boiler room, the sides of the ship are strengthened by very stiff angled iron of greater scantling, and more appropriate shape, than we have hitherto seen employed; the outstanding plane, or edge, being of considerably greater dimensions, than that by which it is secured to the shell; and, consequently, better fitted to resist a strain. These ribs are placed much closer than usual, being pitched at every 12 inches, and join at the bilges with very strong plates and feathers, going straight across the floor, which being formed with considerable rise, gives great depth and strength to those cross ribs, which are further secured to strong iron keelsons, running fore and aft the entire length. On the upper edge of these cross ribs, is riveted angled iron reversed, to give a better bearing for the platform plates; and this angle iron is continued some way above the bilges. Altogether, this floor presents a framework of great strength and stiffness; it closely resembles that of the *Great Britain* steam-ship. A strong (L) iron stringer is carried along the sides about 5 feet below the deck, and the main thwartship beams are of seven-sixteenths iron framed boxwise, presenting the exterior dimensions of the common paddle beam.

The upper and lower deck beams are placed closer, and are of somewhat greater dimensions than we have hitherto seen. They are formed by riveting angled iron on each side of a mid-rib, or feather: forming, together, a (T) iron piece with a triangular gushat at the end, where the beam is made fast to the vessel side. The very substantial wooden cieling in the forward coal hold, we are inclined to consider unnecessary. We formerly alluded to the architectural beauty and propriety of Mr. Denny's designs, to which we must now add our tribute to the strength and goodness of workmanship, which shine forth in this vessel. We would, however, venture to suggest, that, possibly, sufficient strength might be attained with great saving in cost of workmanship, and some increase in internal capacity, by adding considerably to the thickness of the shell; and thus rendering unnecessary, and doing away, with the elaborate and expensive system of angle-iron stays. We think that great increase of durability might thus be attained, and equal, if not superior strength, without increased expense.

We may remark, that the keel of the iron Clyde-built boats is of a similar formation to that which Mr. Grantham describes, as the best method of forming the cut-water and stern post—a stout bar of iron, in this case, about 4½ inches deep × 1¾ broad, to which the first futtock plates are attached, by a double row of rivets. This method contrasts favourably with that recommended by Mr. Gran-than, of building up the keels into the form of the letter U, three plates to each length, or the more expensive method of manufacturing such keel-pieces in solid lengths, as has lately been done by a house in Staffordshire, the Oak Farm Company, we believe. These are made in 8 feet lengths, ¾in. thick, resembling in section the letter U, about 8in. broad in the trough, 5in. in depth, and 14 in. across the flanges. The price charged is £16 per ton.

The iron schooner, *Waterloo*, of Glasgow, presenting, perhaps, some of the very worst, and most characteristic of the faults induced by the old system of registration, extreme shortness for her height, and great bluffness at both bow and stern, still lies in the harbour, affording, we doubt not, to some, a very grateful testimony to the possibility of building an iron sailing vessel, that shall sail worse than a wooden one.

The iron *Eliza*, of Kirkaldy, lately returned from Riga, and now loading for South America, affords a more favourable specimen of this class. She was built about a year ago, by Messrs. Brown, of Kirkaldy. In spite of a very clumsy entrance, fuller than that of almost any other craft we ever saw, she has, we understand, given great satisfaction both in sailing and steering.

River Improvements.—The improvements in the river, to permit small craft to unload above Glasgow bridge are proceeding rapidly. The great weir below the bridge is being removed, and the bed of the river presents a curious appearance, the entire current being directed into a channel of three or four yards in breadth beneath the centre arch. The lowering the bed of the river renders it necessary to pile around the foundations of Stockwell bridge. The river between these two bridges has hitherto presented an unsightly appearance at low water, from the expanse of mud left uncovered; this will now be remedied, removing at the same time the miasmatizing influence attendant.

New Steam Break.—Mr. Peter Robertson, superintendent of the engine department, on the Glasgow and Ayr Railway, has invented, and for some time applied, a very simple and effective steam break. The steam being introduced into a little cylinder, at the side of the fire box, presses upon the piston, which is connected almost immediately to a strong iron or steel hoop, which is thus made to apply exactly, and press with great energy upon the circumference of the driving wheel. The effect is to stop the train in much shorter time than can be effected by the ordinary carriage brakesmen.

Improved Blast-Fanners.—Messrs. Lyon and Lawson, engineers, Camlachie, have adopted an improved blast-fanner machine,—as generally constructed, highly susceptible of improvement. We shall have an idea of the alteration, if we imagine the sides of the common fan case to be removed, and replaced by truncated cones, and the vanes, of which there are three, instead of terminating abruptly, at about half a radius length from the spindle, to be carried into the centre, but diminishing in surface as represented by two quadrants, with their convex sides towards each other. This is said to be an important improvement, owing chiefly, we believe, to the freer access of the air.

Prevention of Smoke.—Mr. C. W. Williams has presented the citizens of Glasgow with the free use of the Argand furnace for a certain period. This step elicited, as it deserved, the warm approbation of the Town Council, through whom the offer was made. Did the authorities of some other great manufacturing towns enter as cordially into measures for the mitigation of the smoke nuisance as those of Glasgow have done, we are convinced that the inhabitants of Manchester, Bradford, Leeds, &c., would not be suffering so hopelessly from the grievance of progressive suffocation. If we were inclined to speculate as to the reason why so little good has resulted from the Argand agitation during the past year or two, we should probably attribute it not so much to the ineffectual qualities of the furnace itself, which we believe capable of giving about as much satisfaction as any yet laid before the public; but to the inflated style of commendation which some of its professional advocates have not scrupled to assume, thereby raising expectations which no moderate degree of merit can satisfy. To the indefatigable inventor, we trust we shall at all times be willing to render whatever praise he merits; but we think, with less pretension he would have had more success.

Gibraltar.—The last parcels of the Artizan I have received, and have forwarded as many of the numbers as I could spare to Cadiz and Malaga, where the work, it appears, is in considerable demand. Here, it has all along been a favourite, and, unlike most favourites, improves upon a better acquaintance.

I was going to make a drawing of a saw-battery, lately erected under the Alamada. This battery mounts eighteen fifty-eight pounders, on traversing planes, and would be the most destructive of any in the garrison, but I was disappointed by the sentry preventing me. I applied to Captain Gordon, Royal Engineers, for permission to complete the drawing, but he told me that the orders on that head were very strict. What absurdity there is in all this! the Daguerreotype would take it all off in a few seconds, in spite of them. I therefore gave up all further attempt. All this part of Spain is in a dreadful state, Algeciras, San Roque, etc. etc., are against the Regent; also Malaga and the whole of the coast. Baron Carondalet, the governor of Algeciras, went to Ronda, &c., to quell some disturbance about three weeks ago, and on his return last week, to his great surprise, he found that Algeciras was in the possession of the rebels, the streets barricaded and fortified with guns: he retired with his troops, amounting to 700 men, to St. Roque, where he remained for three days; but General Concha, who commands the rebels at Malaga, sent word he had despatched 2000 men against him, which however was not the case. The Baron hearing that, came into Gibraltar with the whole of his officers, and the troops reluctantly passed over to Algeciras, where a frigate and a steamer have joined them. Her Majesty's ship Lizard started yesterday from this to Cadiz with the Baron. I trust in my next to be able to send you an account of such of the improvements going on here, as would have interest for your readers. L.

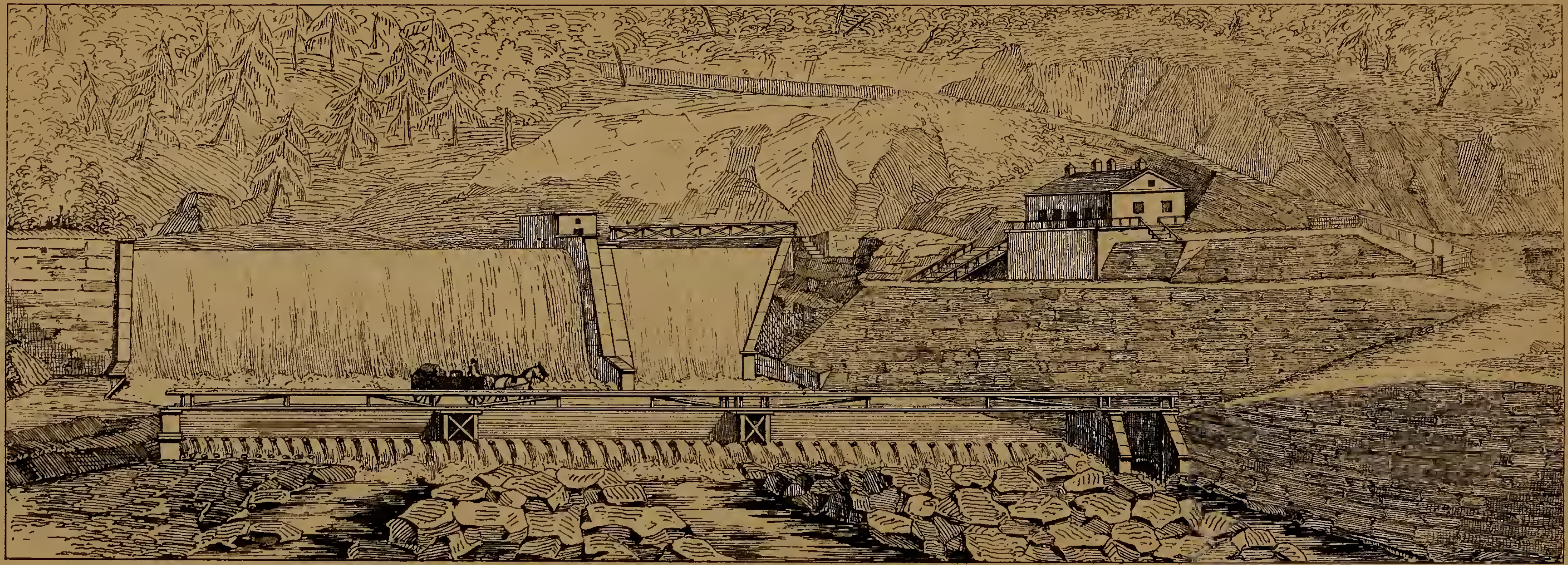
Alexandria.—The last vessel, by some oversight, did not bring out the last number of the Artizan; and I am therefore unable to tell you what the opinions here are of it. Of the preceding numbers there is only one opinion, and I need not say what that is. The work will, I believe, have many subscribers, both here and at Cairo, where it has been introduced into the public library, as well as in various other quarters. It is just the work that is wanted for the infant greatness of Egypt.

The labours of the Pacha, however, for the introduction of modern science, have not been so completely successful as might be wished. He has done very much by the introduction of European discoveries to awaken the reflecting powers of his people, and to assimilate them, as far as possible, in industry and sentiment to the nations he has emulated. But, unfortunately, he could not conquer their slavish prejudices, and his labours for the development of their intellectual resources have been of very imperfect productiveness. It is not that the Arab is deficient in activity of thought, or in comprehensiveness of mind, but that long years of barbarism, and the influence of a barbarising religion, have taught him to bend his head in sensuality and passion; and dares him against the disgrace of accepting the humanizing influence of European science.

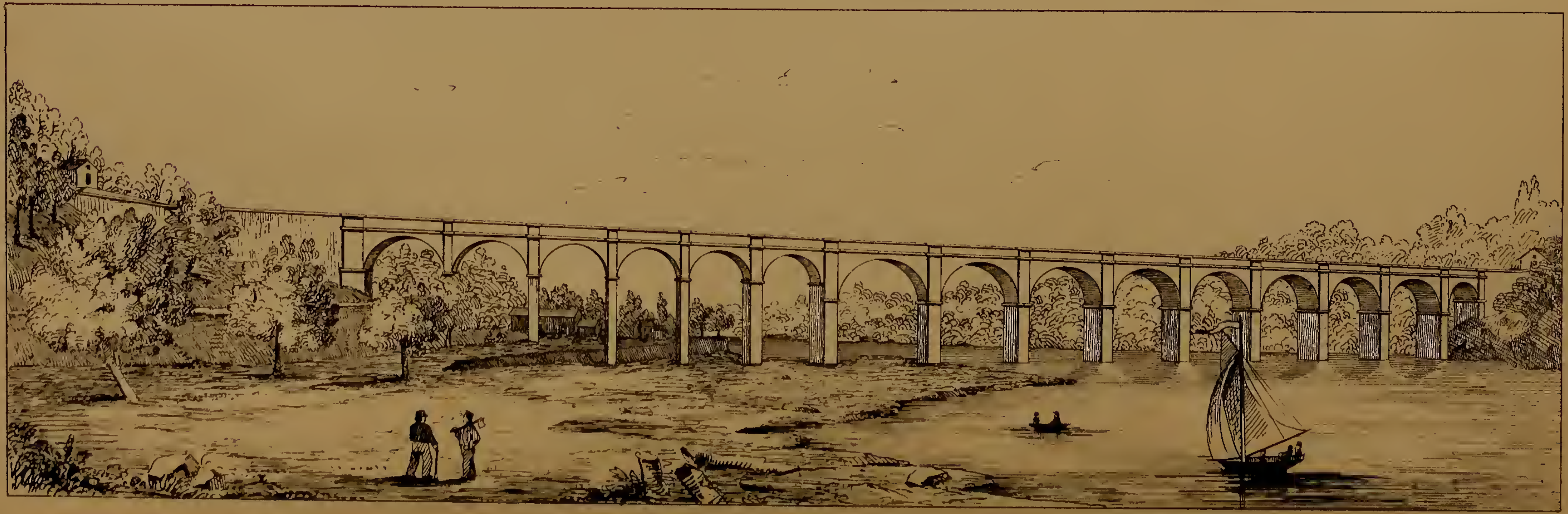
I have set about preparing for you an account of some of the scientific marvels of this marvellous land, which I shall very shortly transmit. I trust to be able to give you a tolerably interesting description of the barage of the Nile, and of some other operations of an analogous kind. D.

Miscellanea.—The "Great Britain" steamer has at length been launched: the details of the ceremony have been given in every newspaper, and now possess nothing of novelty, even if we could suppose they would have much interest for our readers. We take this occasion, however, to add to some of the dimensions of this vessel which appeared in our fourth Number. The length from figure-head to taffrail is 322 feet; length of keel 289 feet; she has four decks; the upper deck is flush, and is 308 feet long; the second deck consists of two promenade saloons, the aft or first, 110 feet 6 inches by 22 feet, and the forward, or second class, 67 feet by 21 feet 9 inches. The third deck consists of the dining saloons; the grand saloon measuring 96 feet 6 inches by 30 feet, and the second class 61 feet by 21 feet 9 inches. The whole of the saloons are 8 feet 3 inches high, and surrounded by sleeping berths, of which there are twenty-six with single beds, and 113 containing two, giving 252 berths. The fourth deck is appropriated to the reception of cargo. The engines and boilers occupy a space of 80 feet in the middle portion of the vessel. The engine-room and the cooking establishment are situated in this part of the ship. There are three boilers; these are heated by twenty-four fires and will contain 200 tons of water. The chimney is 39 feet high, and 8 feet diameter. The vessel is fitted with six masts, the highest of which is 74 feet *above deck.* The quantity of canvass carried will be about 1700 square yards: she will be fitted with the patent wire rigging. Upwards of 1500 tons of iron have been used in her construction and that of the engines and boilers: the draught of water, when laden, will be 16 feet, and the displacement about 3200 tons; the plates of the keel are from one inch to three-quarters of an inch thick, and the other plates about half an inch thick; she is double riveted throughout; the ribs are formed of angle-iron, 6 inches by 3½ inches by half an inch at the bottom of the vessel, and seven-eighteenths thick at top; the mean distance of the ribs is fourteen inches from centre to centre. The boiler platform is constructed of plate-iron, and is supported by ten iron kelsons, the centre ones being 3 feet 3 inches deep. For the purpose of securing additional strength in the engine-room, there are nine intermediate double ribs, and sixteen additional transverse ribs. The beams for the support of the various decks are bars of 3-inch angle-iron, with a plate of 5 inches by half an inch fastened on the side. The deck planks are screwed from below to the angle-iron, and firmly fastened at each end to the vertical ribs, which gives great support to the sides in withstanding pressure both externally and internally. To preserve the hull from warping horizontally, there are diagonal tension-bars placed between the angle bars and deck planks.—The "Cormorant" is fitted with double bulk heads of iron abaft the boilers, the intervening space being filled with water. The water is supplied from the paddle-wheel, and a continual current is kept up when the vessel is in motion: by this expedient the holds and cabins are kept quite cool, the heat of the boiler being effectually prevented from penetrating to them.—The "Victoria and Albert" Steam Yacht has been tried, and is said to perform extremely well.—Mr. Cowe's improved launch, of which we lately gave a short account, has been tried by the government authorities, and been found to give much satisfaction.—The large new dock constructed by Messrs. Grissell and Peto at the west end of the Woolwich Dockyard, was opened to-day, for the first time, to admit the "Chichester," 50 guns, launched on Wednesday last. When the gates were opened, the dock was filled with water from the basin in thirty-eight minutes, and the quantity required reduced the level of the spacious basin upwards of eighteen inches.—The operations on the wreck of the "Royal George" are still continued. Numerous pieces of the keel and the fore-foot, and part of the stem, have recently been taken up.—The "Mermaid" Steamer has been purchased by Government, and has been brought down from Messrs. Rennie's to Woolwich.—The Lords of the Admiralty have decided upon building a new class of brigs, of 12 guns, which will supersede the old 10 gun "floating coffins." The new 12-gun brigs are to be armed with ten 25 cwt. 32-pounders and two 18-pounders. This is a class of vessels which it is expected will do credit to the service. It is stated that Mr. White, of Cowes, is to give in designs for building a brig of the new class, and that Mr. Fincham, of Chatham, is to give one also.—From a conversation which has taken place, in the House of Commons, between Dr. Bowring and the Chancellor of the Exchequer, it appears probable that this country will shortly have the advantage of a direct mail-communication with Smyrna and Constantinople.

PLATE XXI



VIEW BELOW THE CROTON DAM.



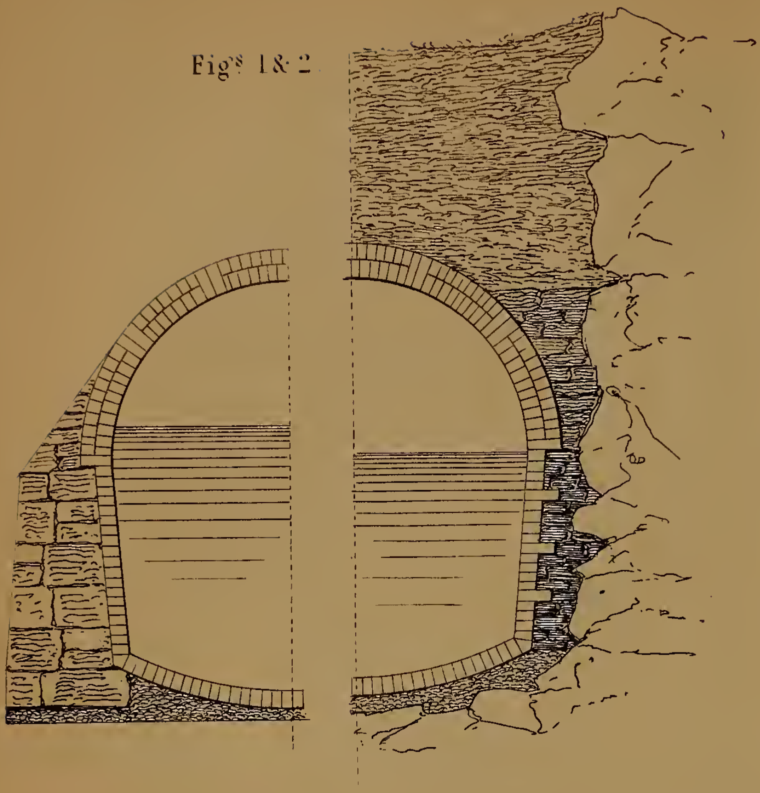
J. R. Jobbins litho

CROTON AQUEDUCT AT HARLEM RIVER

PLATE XXII

SECTIONS OF THE CROTON AQUEDUCT.

Figs 1 & 2.



Figs 3 & 4.

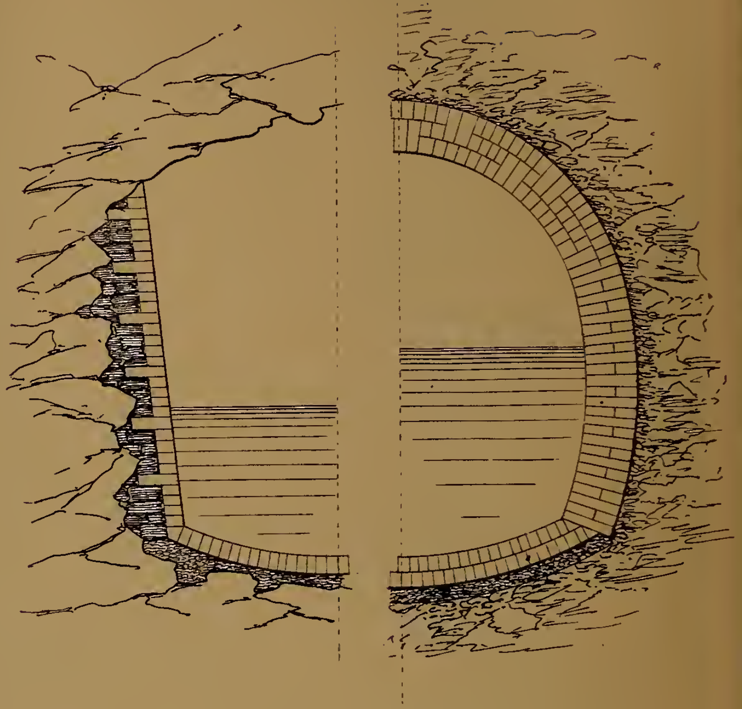
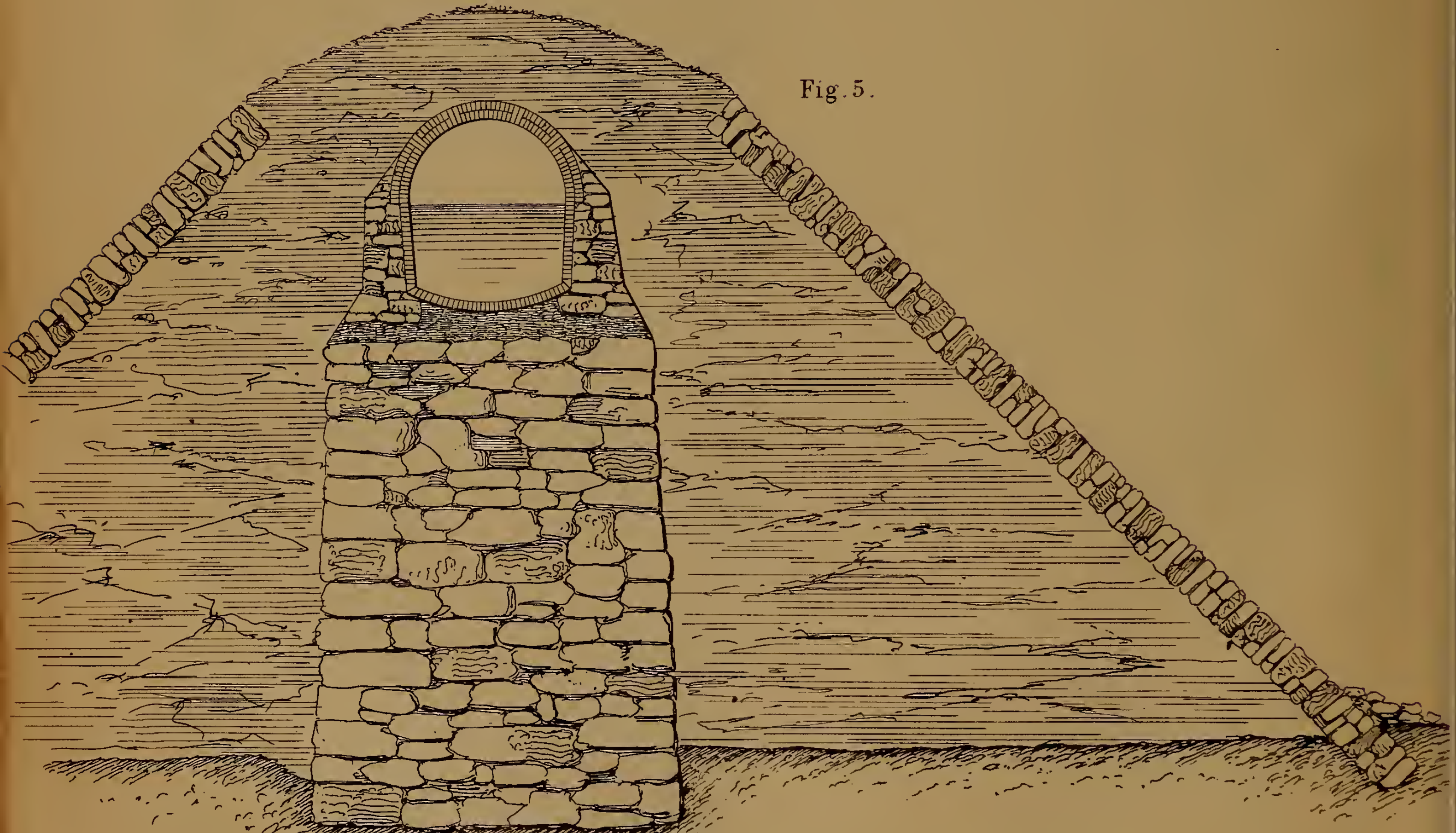


Fig. 5.



J. R. Jobbins litho.

STEAM ENGINE PISTONS — MARINE.

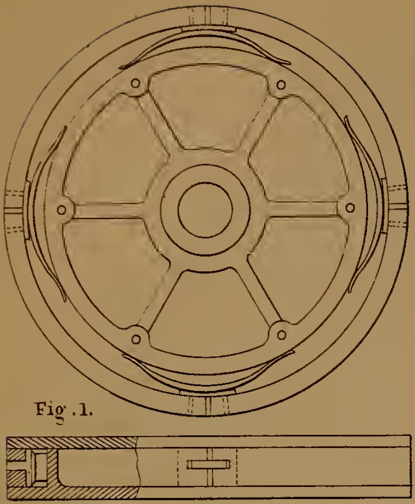


Fig. 1.

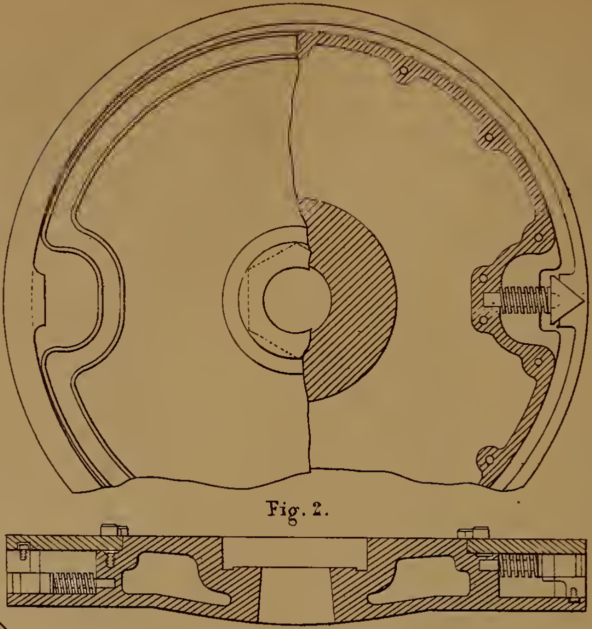


Fig. 2.

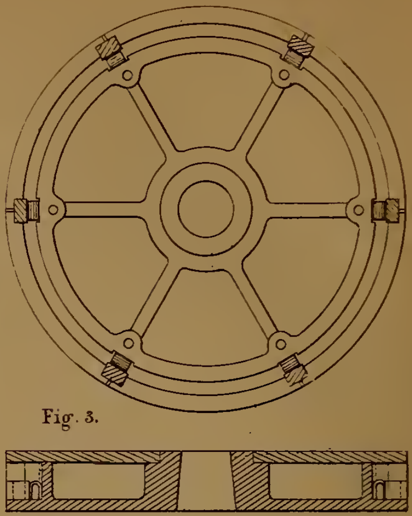


Fig. 3.

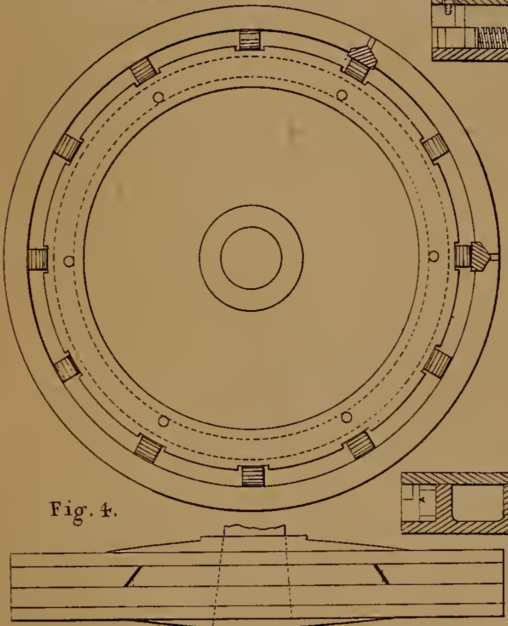


Fig. 4.

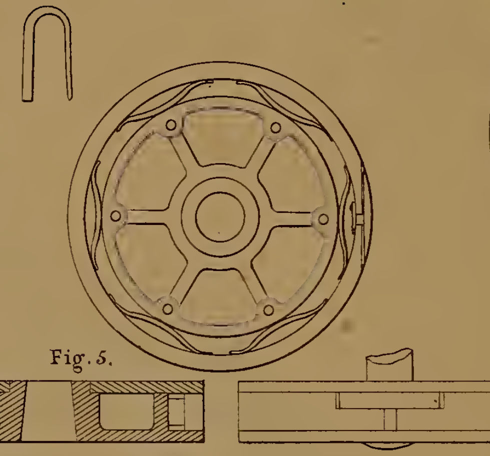


Fig. 5.

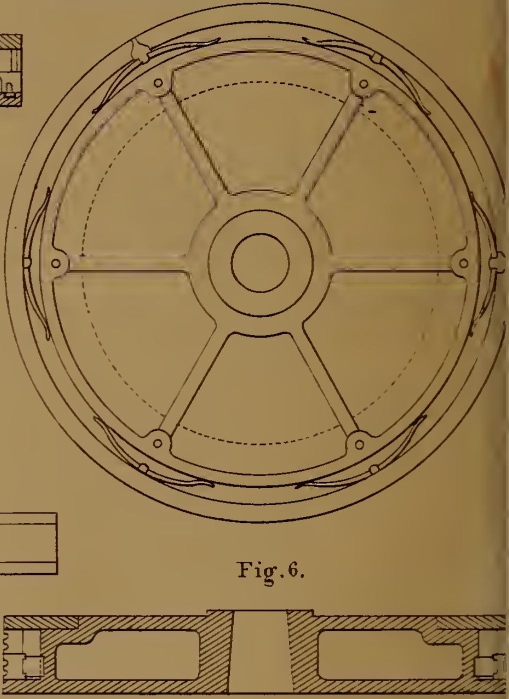


Fig. 6.

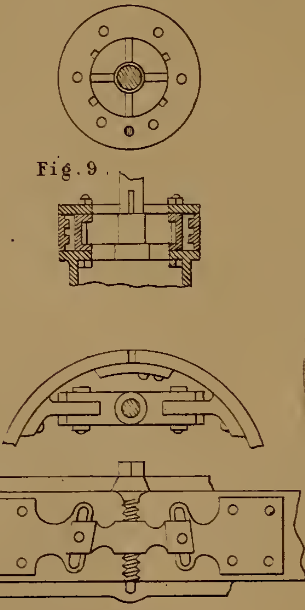


Fig. 9.

Scale of the above portion
1, Inch to the foot.

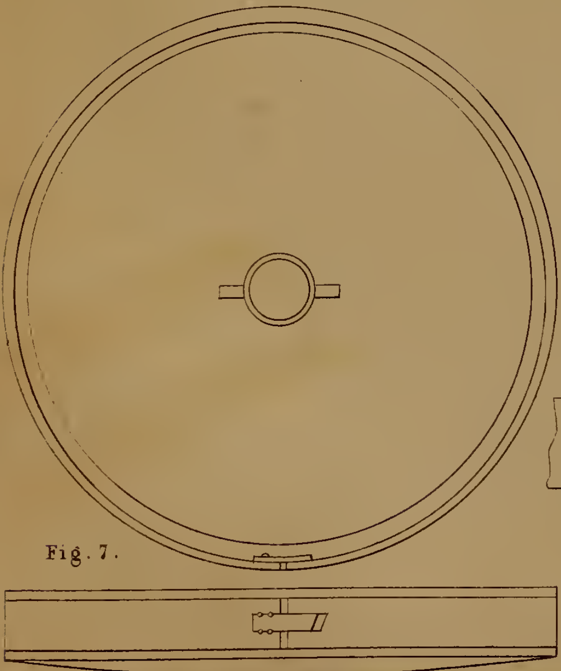


Fig. 7.

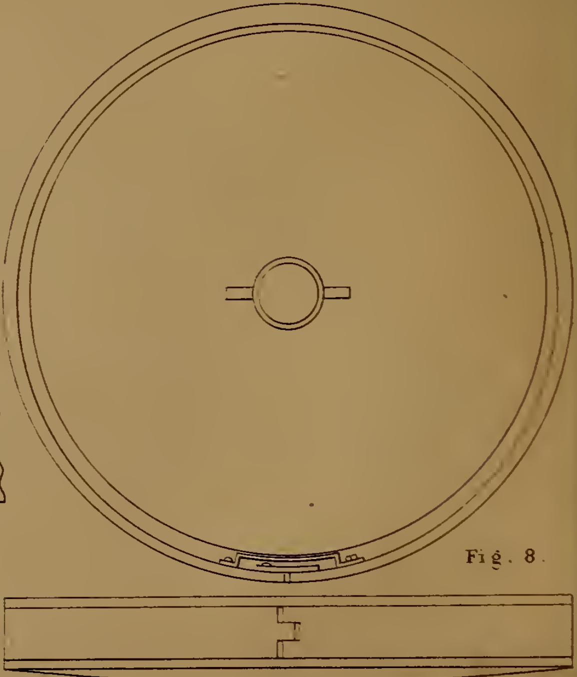


Fig. 8.

Scale ½ Inch = 1, foot.

PARSONS & BUNNEYS IMPROVEMENTS ON THE STEAM ENGINE.

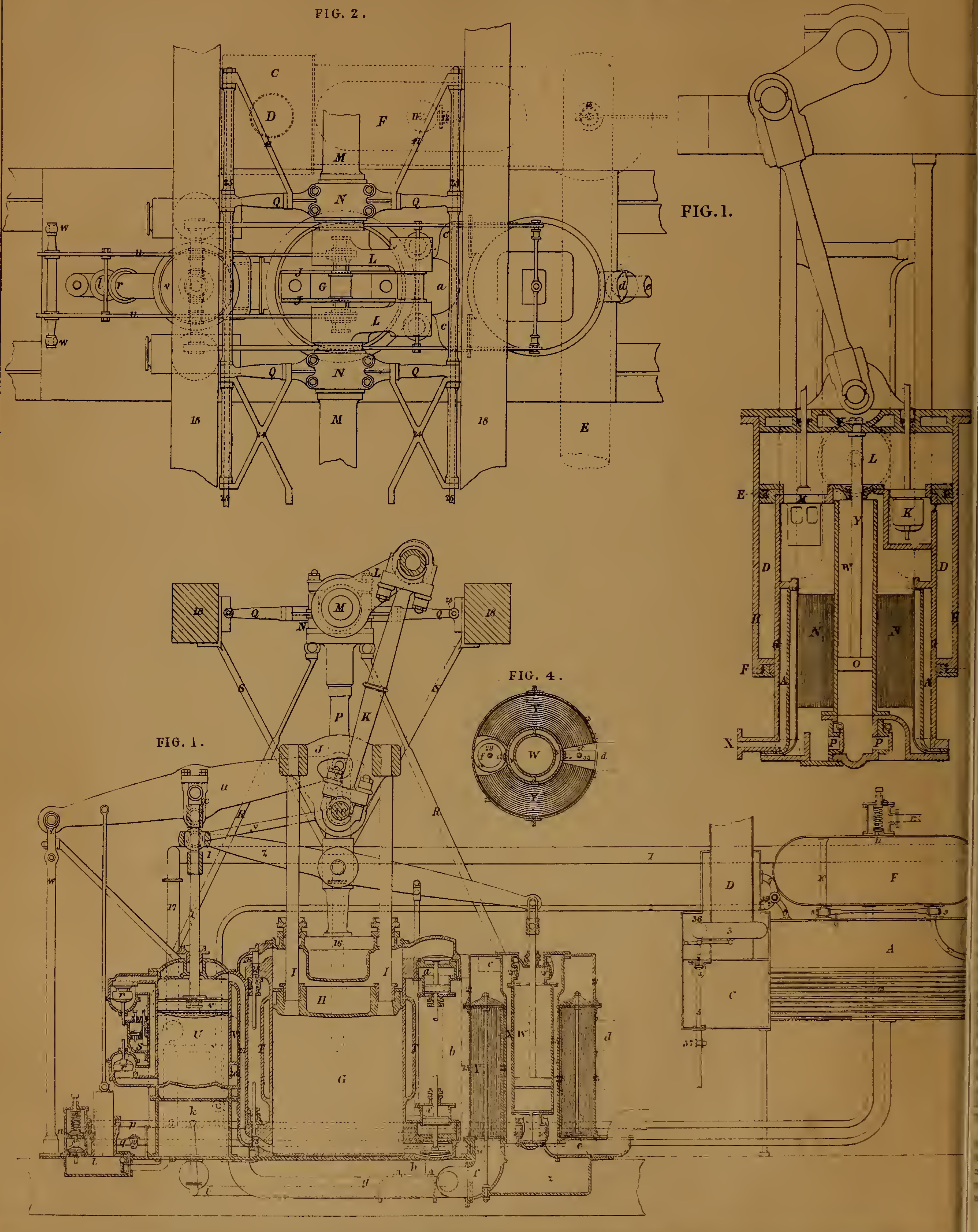


FIG. 2.

FIG. 1.

FIG. 4.

FIG. 1.

THE ARTIZAN.

No. VIII.—AUGUST 31st, 1843.

Art. I.—THE CROTON AQUEDUCT.

Illustrations of the Croton Aqueduct. By F. B. Tower. New York: Wiley and Putnam. 1843.

The Croton aqueduct, a work recently completed, for supplying New York with water, has a double claim upon our attention:—first, as a great and successful engineering undertaking; and second, as an instrument for improving the health and comfort of towns, and thereby ameliorating the condition of that section of the community in whose behalf our sympathies are more immediately enlisted. The badness and insufficient quantity of the water with which the greater number of our towns are supplied, has long been felt to be one of the most active causes of the disease and depravity which have spread themselves among our working population. In London, for example, the water supplied to the poorer class of dwellings, where it has generally to be stored in decayed casks or cisterns, is absolutely unfit to be drunk; and the poor man is driven to the beer-shop as the only place where he may assuage his thirst. In these days of temperance, however, this expedient is no longer practicable; and the necessity is fast becoming imperative to supply the poorer classes with wholesome water. We trust that this measure will be taken up in connexion with the present temperance movement, to the success of which, in London at least, we are confident it is indispensable.

We purpose, on some future occasion, to show in some detail the great imperfections in the existing means of supplying London with water, and the necessity that the matter should be taken up either by the City or by the State, to the end that some great work may be undertaken by which an adequate supply of *good* water will be obtained. At present we would merely remark, that, of all the varieties of water furnished by the London water companies, that supplied by the New River Company is perhaps the least objectionable, as it is at least drawn from the river sufficiently far up to escape the sewers and other contaminations of the metropolis. But even the New River water is exceedingly turbid and impure; and, as the aqueduct is a mere open ditch, the water is of course subject to innumerable pollutions. In the hay season, for example, much of the hay blown into the water lies there and decays—turning the water into weak hay tea, and generating countless animalculæ. Then, again, one may occasionally observe dead cats and dogs, and other similar abominations, floating in the stream; and although the Company certainly endeavours, as far as possible, to hinder such nuisances, yet it cannot altogether prevent them. We do not pretend to say how far the actual salubrity of the water may be affected by such intermixtures, but we are at least confident that the water is excessively bad; and, even were it pure as that of Castalia, it could only be tasted with disgust when coupled with such revolting associations.

The Croton aqueduct derives its name from the Croton river, the waters of which it conveys to New York. This river rises in the county of Putnam, about fifty miles from New York, and is remarkable for the purity of its water. It flows over a rocky bed, and the land contiguous to its banks has long been well cleared of trees, so that the rains have no tendency to corrupt its waters with decayed vegetable matter. The average flow of water in that part of the river where the aqueduct begins, is about fifty millions of gallons per day, and the flow in seasons of drought is about twenty-seven millions of gallons per day. The aqueduct is thirty-eight miles long; and at the point where it meets the river a dam has been constructed which elevates the level of the water about 38 feet, and sets back the water about six miles, forming a large sheet of water, which is called the fountain reservoir. This reservoir is estimated to contain six hundred millions of gallons, and, with the reservoirs in the city, would supply one-third of a million of persons with water for four months, at the rate of twenty gallons per day for each individual. The banks of the fountain reservoir are generally steep and rocky: those parts of it less than four feet and a half deep have been excavated to that depth, and the whole of the bottom and sides were stripped of every particle of vegetation before the water was dammed back. In this reservoir any impurity brought down by the river has time to subside on its way towards the aqueduct, so that the aqueduct carries off none but pellucid water. The quantity of water the aqueduct is capable of conveying in the twenty-four hours is sixty millions of gallons, which is ten millions of gallons more than the total average flow of the river.

Before proceeding further, it may be satisfactory if we state the circumstances in which the formation of this aqueduct originated. So far back as the year 1774 the increase in the size of New York had caused the want of a more abundant supply of water to be severely felt; and in that year the corporation constructed a reservoir, and various other works, with the intent of palliating the evil. The American war, which broke out in the following year, put a stop to these procedures, and the project was suffered to languish until the year 1798, when a recommendation was made to the common council to bring the Bronx, a river in the vicinity, into the city by an aqueduct. This proposal, however, was rendered nugatory by the formation of a company called the Manhattan Company, which undertook to supply the city with pure water; but instead of bringing in a river, this Company resorted to the futile expedient of sinking wells, and after many years of expensive exertion achieved nothing of practical moment. In the year 1822, the yellow fever broke out in New York, and the malignity of the disease was considered to be greatly aggravated by the scarcity of water then prevailing. This calamity roused the attention of the citizens, and active measures were at once taken to bring in the river Bronx; but these measures were defeated by the Sharon Canal Company, which about this time obtained a charter, and by virtue of this charter they claimed the waters of the Bronx, and of various other streams. The chairman of the Sharon Company, however, suggested the Croton, as being a more appropriate stream than the Bronx for the supply of the city, and one to the use of whose waters there would be no impediment.

In 1832, the cholera broke out in New York, and the mortality was believed to be much increased by the deficiency of wholesome water. Active measures were now resolved on: the preliminary surveys were made. An Act of the legislature was procured in 1834, to authorize the commencement of the work; and in 1837, the aqueduct was begun. The delay between the time of the passing of the Act and the commencement of the work was occasioned chiefly by the difficulty of deciding on the merits of a number of rival plans submitted to the Commissioners. Some of these plans proposed the conveyance of the water in an open drain, others in a drain covered in the neighbourhood of villages. Other plans, again, contemplated the use of iron pipes, some of them being proposed to be laid along the surface of the ground, and in other cases they were to be laid on the level, appropriate supports being furnished for the pipes at suitable distances. These plans had all very obvious objections. In the first place, an open drain would never furnish New York with *pure* water, and in winter the aqueduct would be frozen up. The latter of these objections would also apply to unprotected pipes laid on supports, while by causing the pipes to follow the inequalities of the ground, the flow of the water would be much impeded. It was found, moreover, that iron pipes, to give a sufficient area, would be more expensive than a stone culvert, and at the same time it was conceived to be less durable. The plan of a stone culvert led on the level, or more properly at a slight inclination, was therefore the plan adopted.

In the prosecution of this work one serious difficulty presented itself. New York is situated on a small island; and as the water had to be drawn from the main land, it had to pass an arm of the sea, called Harlem river. Three modes presented themselves of leading the water across: one was by means of a pipe lying on the bed of the river, another by a tunnel beneath the river, and the third by means of an aqueduct bridge. The difficulties experienced in the formation of the tunnel beneath the Thames deterred the American engineers from resorting to the plan of a tunnel, and it was agreed that the water should be carried across by a three feet pipe resting on a bridge, the arches of which should be sufficiently high to offer no obstruction to the navigation of the river. At the Manhattan valley, a similar expedient has been adopted to obviate the necessity of building a very high bridge. These are the only parts of the aqueduct where iron pipes are introduced. The whole of the remainder consists of a stone culvert lined with brick.

The aqueduct terminates in a large reservoir in New York, termed the receiving reservoir, which covers an area of thirty-one acres, and contains one hundred and fifty millions of gallons. The walls of this reservoir are composed of earth faced with stone. The earth was carefully selected, and rendered compact and water tight, by beating it together with the spade when wet. The walls are 20 feet thick on the top, and have a slope on the outside of 3 feet in 1, and on the inside of 1½ feet in 1. The outside is cased with masonry, 4 feet thick, set in mortar, and the inside with masonry 1¼ feet thick, without mortar. The depth of the water varies from 20 feet to 30 feet, according to the irregularities of the bottom; and the walls rise 4 feet above the highest water level. The reservoir is divided by a strong wall into two compartments, communicating with each other by pipes and stop cocks, to the intent that if a leak or damage occurred in one section of the reservoir, it might be emptied and repaired, the other compartment remaining meanwhile in use. The reservoir is, of course, supplied with an overflow-weir for conducting away the surplus water. The surplus water descends into a well, from whence it is conveyed by a sewer into the river.

The water is conveyed from the receiving reservoir into another smaller reservoir, situated near the centre of the town, called the distributing reservoir, the purpose of which is to have an efficient head of water among the densely crowded buildings, where the other reservoir could not be placed. The distributing reservoir is 420 feet square at the top, and 436 feet square at the base, and is calculated to hold twenty millions of gallons. The walls are constructed in the following manner:—First, an embankment of puddled earth is formed of suitable strength, and this embankment is faced with hydraulic masonry 1¼ feet thick. The outside of the embankment is also covered with a wall of masonry, and this wall is built hollow to within 8 feet of the water level, with the view of preventing the frost from acting injuriously on any exudation. The walls are 17 feet thick at the top, and 76 feet thick at the bottom. This reservoir is also divided into two partitions by a wall: the bottom is composed of concrete 1 foot thick.

Such is a general outline of this great work, and we must now endeavour to give some practical information relative to its details. We may here press Mr. Tower into our service, though we have been unable to make much use of him hitherto. His practical statements are for the most part very good, but he has no talent for arrangement, and we have been obliged to classify and translate his general descriptions to save our readers from bewilderment. He may now, however, we conceive, be trusted by himself; and we here introduce him to our readers.

The Dam.—"The masonry of the dam is about 8 feet thick at the top and 65 feet at the base; it is built in a vertical form on the upstream side, with occasional offsets, and the lower face has a curved form such as to pass the water over without giving it a direct fall upon the apron at the foot; this apron is formed of timber, stone, and concrete; and extends some distance from the toe of the masonry, giving security at the point where the water has the greatest action. A secondary dam has been built at a distance of 300 feet from the masonry in order to form a basin of water setting back over the apron at the toe of the main dam, so as to break the force of the water falling upon it. This secondary dam is formed of round timber, brush wood, and gravel; it may be seen in the picture directly under the bridge which extends across below the main structure.

"On the upstream side of the masonry of the dam, an embankment of earth is filled in, extending 275 feet from the masoury at the base, and extending from the masonry with a slope of 1 foot in 5 on the top.

"The form which has been adopted for the face of the extension of the overfall is a reversed or double curve, which would be easily recognised as *Hogarth's line of beauty:* the overfall for the original dam has a plane face with a curve at the base."

This, we should have remarked, is the dam across the Croton, which forms the fountain reservoir. A view of the dam is given in Plate XXI.

Levels.—The surface of the fountain reservoir is 166½ feet above the mean level of the tide at New York, and the following are the descents in the different parts of the aqueduct.

	Feet.		Miles.		Feet.
The 1st plane of Aqueduct extends	26099·72,	or	4·943,	and the descent	2·94
The 2nd plane of ditto extends	148121·25,	or	28·053,	. .	30·69
Length of pipes across Har. River,	1377·33,	or	0·261. .		
Difference of level between extremes of pipes . .	. .	. .	. .	. .	2·29
The 3rd plane of Aqueduct extends	10733·14,	or	2 033,	. .	2·25
Length of pipes across the Manhattan valley . . .	4105·09,	or	0 777.		
Difference of level between extremes of pipes . .	. .	. .	. .	. .	3·86
The 4th plane of Aqueduct extends	10680·89	or	2·023,	. .	1·60
	201117·42		38·090		43·63

The descent on the several planes are, 7⅛, 13¼, 13¼, and 9½ inches per mile respectively; and the *extra* fall of 2 feet at the Harlem river, and 3 feet at the Manhattan valley, is to compensate for the obstruction occasioned by the introduction of bent pipes. The surface of the receiving reservoir is 119 feet above the mean level of the tide at New York, and the surface of the distributing reservoir 115 feet. The velocity of the water in the aqueduct has been found to be about a mile and a half per hour, when two feet deep.

Culvert, or Water-way of the Aqueduct.—This is the most important part of the work, and one of which we must endeavour to convey a clear conception. The forms of the culvert, of course, vary with the situation; and it is impossible we can give every variation; but the chief forms will be made intelligible enough by a reference to Plate XXII.

Fig. 1 is a half-section of the aqueduct, showing the form adopted in the case of earth excavations. The foundation is of concrete, the sides of stone, and the top of brick, the sides and bottom being also lined with brick. After the culvert is formed, the earth is filled in on top of it, to the height of 3 or 4 feet.

Fig. 2 shows the mode of forming the channel in an open cutting through rock, and which is in all respects the same as the preceding, except that the side walls rise so as to fill the space between the rock and the arch.

Fig. 3 represents the aqueduct in tunnel-cutting in rock, and

Fig. 4 in tunnel-cutting in earth.

Fig. 5 is a section of the aqueduct in those situations which require the aid of an embankment to preserve the proper level. The stone wall supporting the culvert is built dry, and to obviate the effects of any settlement, the flooring of concrete beneath the bricks is made thicker than usual, and with a larger proportion of lime, and the inside of the culvert in such situations is plastered with mortar. We do not see how there can be much virtue in these expedients; the plastering might have availed something if it had been done with Indian rubber cement.—We are, however, interrupting Mr. Tower.

Waste-Weirs.—"At suitable places on the line of the aqueduct, waste-weirs are constructed to discharge surplus water. They are constructed in one side of the channel-way, in such manner as to allow the water to flow off when it rises above a given level, and arrangements are also made at these places to close the channel-way entirely, by means of stop-planks, and to discharge the whole of the water through waste-gates; so that the water might be running from the fountain reservoir through a portion of the aqueduct, and discharging from these waste-weirs, while the remainder of the channel-way, or portions of it, would be drained so as to admit of inspection or repairs. There are six of these waste-weirs constructed for the aqueduct."

Ventilators.—"For the purpose of ventilation hollow cylinders of stone are erected over the top of the aqueduct, and rising above 14 feet above the surface of the ground, or earth covering. These occur every mile, and every third one is constructed with a door, to afford an entrance to the aqueduct.

"Those allowing an entrance have an interior diameter of 4 feet, and the others have an interior diameter of 2 feet; each, however, slightly diminishing towards the top. An iron grating covers the top to prevent any thing being thrown in.

"Besides these ventilators, there are openings 2 feet square in the top of the roofing arch, every quarter of a mile: they are covered with a flag-stone and the place is marked by a small stone monument projecting above the surface of the ground. These may be useful to obtain entrance to the aqueduct, or to afford increased ventilation should it ever become necessary."

Materials and Workmanship.—"The bricks used in this work are generally of quite a different character from those used in ordinary house-building; being harder burnt, and of a superior quality of material. They are required to be burnt to such a degree of hardness that they present a cherry red, or brownish colour, and give a clear ringing sound when struck; and when broken, must present a compact and uniform texture. All bricks brought upon the work which are soft and of a pale colour, such as are usually denominated *salmon brick*, are rejected. Those which are used possess nearly the hardness and durability of ordinary building stone, and are calculated to resist the action of the water, to which they will be exposed.

"The advantage of using brick is, that a smooth channel, offering little resistance to the flow of water, can be formed with less expense than with stone, and greater security can be obtained against any leakage; for, besides the coat of plastering which covers the face of the walls and the top of the concrete, there is also a mortar joint between this plastering and the brick work. The bricks being of good form and easily handled, can be more expeditiously and closely laid than the face of a wall of stone, and afford a smooth and uniform face to the wall with less expense. They are required to be bedded full and flush with mortar, so that on lifting one from its position in the work, no imperfections be discovered, but the impress of the brick be found distinct throughout.

"The proportions of the mortar for the brick work are, two parts of sand to one of hydraulic lime.

"The inverted arch of brick, as well as the brick-facing on the sides, is four inches thick, and the roofing arch of brick is eight inches thick."

The concrete appears to have been compounded with much care.

"In forming the concrete a mortar is made by mixing three parts of sand with one of hydraulic lime, and then mixing about three parts of stone, broken to a size allowing them to pass through a ring an inch and a half in diameter. Having thoroughly mingled the broken stone and mortar, the concrete is placed in its proper position and form, and brought into a compact state by using a *pounder;* and is then suffered to remain until it is set, or become indurated, before any work is commenced upon it. The object should be to mix as many stones or pebbles as will thoroughly bed in the mortar, allowing none of them to come in contact, but all to be enveloped in mortar. This forms a body which becomes indurated, and makes a foundation under the whole length of the aqueduct like one continuous stone."

The following information, too, is important:—

"The side walls are laid up in a character of workmanship styled '*rough-hammered work;*' the stone required to be of sound and durable quality, and laid in a manner to render the work water-tight. Though attention is given in some degree to insure a proper bond to the wall, yet the point more particularly attended to is to make it compact and impervious to water. The bonding of the wall is not by any means disregarded, in all situations where it is required; yet the position of the work generally, where it is in excavation below the natural surface of the ground, renders such precaution of less importance than that of making it compact. The mortar used in these side walls is formed by mixing clean sharp sand with hydraulic lime, using the proportions of three parts of the sand to one of the lime; and these are thoroughly mixed and incorporated before they are wet: when this mixture is wet and thoroughly worked, it is used immediately, and always kept properly tempered, so as to render it plastic, and to prevent any disposition to become hardened before it is in the wall. After the side walls are finished, and the concrete between them has received its proper form, a coating of plastering, about three-eighths of an inch in thickness, is put on over the surface of the concrete and on the face of the walls before the interior facing of brick is commenced. The proportions of this plastering are two parts of sand to one of the hydraulic lime."

These comprise all the details of any importance connected with this interesting work; and we have only now, in conclusion, to direct the attention of our readers to the bridge across the Harlem river, which they will find figured in Plate XXI. Some of the piers of this bridge have a rock foundation, and the rest are founded on piles. The piles are driven at a distance of $2\frac{1}{2}$ feet from centre to centre, and the intervening spaces are filled with concrete to a depth of 3 feet. The height from the foundations in the river to the top of the bridge is 150 feet; the width across the top 21 feet; and the pipe which conveys the water is covered with earth, to shield it from the frost. There is only one pipe at present, but provision is made for adding more whenever the demands of the city render the measure necessary.

Cost.—The *estimated* cost of the aqueduct and reservoirs was about five and half millions of dollars: the *actual* cost was about nine millions of dollars. The cost of pipes, &c., for distributing water throughout the city will be about three millions of dollars; making the total cost of supplying New York with water, twelve millions of dollars, or about 2,500,000*l.* sterling.

We cannot conclude our notice of this great work without expressing our admiration of the spirit which prompted the undertaking, and the skill with which it has been executed. We do not know whether there may be equal spirit and skill lying latent in our own country, but certainly, at least we have no such work. If we were to confess all we thought, we should probably say, that in all the more difficult enterprises of engineering the Americans are leaving us behind. We have upon us the rust of age, and the stringency of precedent, while they are young and unfettered; and if their fancies are sometimes crude and visionary, they are at least free from the languor and indocility which wait upon a learned refinement. Our engineers, certainly, for the most part, make *better things* than the Americans; but that is only tantamount to saying that more money has been placed at their disposal: and although their merits are no doubt great, we fear that, with equal success, the Americans have by much the superiority in the two grand points of economy and adventure.

Art. II.—OBSERVATIONS ON THE ACTION OF THE RECIPROCATING PARTS OF MACHINERY.

This subject is thoroughly investigated in the introductory chapter of Mr. Farey's work on the Steam Engine—is briefly discussed in a paper read by Mr. Russel before the Edinburgh Society of Arts, with the rather ridiculous title of "The Fallacies of the Rotatory Steam Engine"—and, more recently, is judiciously commented upon in Professor Moseley's Memoir upon the Indicator. The subject is sufficiently interesting, however, to justify our making some remarks upon it, and sufficiently misapprehended to excuse our trespass upon ground which has been explored already. The crank fallacy, and the reciprocating fallacy, are two that have generally gone hand in hand: the former, the more plebeian, is, it is true, now principally confined to "practical men," having been fairly given up by the more scientific blunderers. Shorn of its honours, derided and routed out, it still, however, continues to drag on an obscure and ambiguous existence, like those solitary reptiles who make up in extraordinary tenacity of life what they want in every other element of vitality. This first error, that of a loss of power by the crank, may be briefly disposed of, on the principle of virtual velocities, in connexion with the consideration that as no power can be created by a mere combination of levers, so none can be destroyed thereby. The second, and more respectable fallacy, that power is absorbed in incessantly producing and destroying the motion of the reciprocating parts of a machine, we shall consider at some length,—regard being had, in our remarks, rather to the "number, character, and qualifications" of the holders of the obnoxious doctrines, than to their intrinsic importance.

First of all, then, it is obvious that it takes some power to put a beam in motion, supposing it balanced upon its centre; and when motion has been communicated to it, an equal amount of force, applied in the opposite direction, is required to destroy the motion. To one contemplating the heavy masses of matter to which motion is alternately imparted and opposed, the inference is natural that a proportion of what would be otherwise available power is inoperatively expended, first in overcoming inertia, and, second, in destroying momentum. The working-beams and side-levers of steam-engines afford the most familiar example of this. We there see a weight of several tons, including the various attachments, moving with considerable velocity, alternately in opposite directions. Some other machines, we shall find, supply more striking illustrations, such as planing machines, stone-cutting machines, reciprocating saw-mills, &c. In fact, instances of incessant reciprocation are not much less common than instances of continuous rotation.

Unlike the loss from friction, atmospheric resistance, viscidity, and imperfect elasticity, we shall find that this loss, if any exists, is of a nature susceptible of mathematical investigation. We shall take the *reductio ad absurdum* plan, and show that if the ultimate loss be anything, it must in some instances be so great as to absorb the whole power of the machine.

To proceed, then, with the case of an ordinary engine-beam, with the usual connexions of piston, connecting-rod, or plunger-pole, &c. The inertia of the beam, or its resistance to motion, may be regarded as equivalent to that presented by a certain weight at each extremity. It is a familiar problem in theoretical mechanics to determine at what distance from the axis the matter of a beam must be concentrated, in order to oppose the same resistance to motion that the beam does in its natural state. This distance is called the radius of gyration, and the point the centre of gyration. Assuming, again, any distance—such, for instance, as half the length of the beam—we can determine conversely what proportion of the mass placed at that distance will present an equivalent resistance: this may be termed the mass of equivalent inertia for that radius.

Suppose the beam in question to be a prism, of which the length bears a great proportion to the other dimensions; then, if we imagine one-third of the weight to be placed at each extremity, and the rest to be annihilated, the resistance to angular motion would continue the same, and one-third would represent the mass of equivalent inertia. In a common beam we may take one-fourth as the mass of equivalent inertia at the extremity of the lever: to this must be added the gross weight of the attachments to the outer ends, and that of the connexions to the intermediate parts, reduced, in the proportion of the square of their actual distance from the main centre, to the square of the half length of the beam.

Take, then, the case of a winding engine at an inclined plane on one of the coal railways in Lancashire—cylinder, 18in. diameter; length of stroke, 6ft.; heavy beam, which may weigh from 2 to 3 tons, one-fourth of which call 13cwt.; weight of the other reciprocating points, say 27cwt.; total, 40cwt. We may then consider the engine-beam as a simple weigh-beam without weight, but having suspended at each end a scale-pan containing 20cwt. This engine sometimes makes 40 strokes per minute, giving a velocity of 480ft. per minute, or 8ft. in the second; in the fourth part of a stroke, or three-eighths of a second, this weight has had a velocity of 12ft. per second communicated to it; the maximum being to the average velocity as the semi-circumference to the diameter; so that a force had been in operation which, acting for one second, would produce a velocity of 32ft. per second.

To put 2 tons in motion, at a velocity of 12ft. per second, requires a mechanical power equal to the descent of that weight through the space it would fall, freely to acquire that velocity—that is, through 2ft. 5in.: thus, during each half revolution, or single stroke of the engine, we have a force expended equal to 2 tons, or 4480 lbs., moving 4ft. 10in.; but the piston having an area of 254 square inches, it will be found that a pressure of 14 lbs. per inch is absorbed in moving and checking the reciprocating parts. The ordinary pressure in the boiler may be from 25 to 30 lbs.; but the actual pressure on the piston cannot, at that speed, exceed 15 or 18 lbs.; and thus we should have three-fourths or seven-eighths of the whole power spent in moving the working parts. In spite, however, of this great deduction, the engine is found to perform its work with ease; which could not be the case if the loss were a real one. In fact, on the above computation, supposing the velocity to be somewhat increased, it would take more than the whole pressure of the steam merely to keep the engine going. So far, however, from this being the case, it is found that when the pressure on the piston is constant, the useful effect is in the direct proportion of the velocity.

Let us now take a different example; suppose the case of a pumping-engine with 72-inch cylinder, and 10 ft. stroke, weight of plunger-pole, 30 tons, with balance weight at other end of beam; weight of reciprocating parts referred to the end of the beam 7 tons, total reciprocating weight in lbs. 150,000. Suppose the number of strokes to be ten per minute, and a pause of half a second to be made after each single stroke, the average speed of the piston would be 240 feet per minute; and conceiving the acceleration and retardation to take place uniformly, the greatest velocity will be 480 feet per minute, or 8 feet per second, which is the velocity a body falling freely through the space of one foot would attain. Now, taking the power spent in retardation as equal to that spent in acceleration, we have for each double stroke of the engine a weight of 150,000lbs. moving 4 feet, (equal to 600,000lbs. through 1 foot,) which, reduced in the proportion of 4 : 20, gives 30,000lbs. as the constant pressure upon the piston, = $7\frac{1}{2}$lbs. per square inch, supposing both strokes to be effective, but = 15lbs. supposing only one,—an amount which in most cases would be more than sufficient to absorb the whole power of the engine.

In the above computation, we have proceeded on the authorized method of adding the force required to put a body in motion to that required to destroy the motion, and presented the two as the sum of the power expended; but the truth is, that these two forces, being exerted in opposite directions, not their sum, but their difference should be taken, and these being for the most part equal, they neutralize each other, and the actual power absorbed is just nothing at all. The power exerted in overcoming the inertia at first is merely lent for a fraction of a revolution, and each time the crank arrives at the dead centre every atom of it has been returned to the machine through the medium of the crank pin, and been rendered available.

We hear much of the advantages of the piston having a spring, or steam cushion to come down upon. We think this has been overrated. The motion of the piston is so gradually and gently checked by the crank, as to render other means superfluous, and one of the main advantages of lead is in preparing for the ensuing stroke, by having the steam-ways filled up in time. When we think of the enormous quantity of motion existing during the middle of the stroke, and the method in which it is all given out before the end, we cannot but admire the beautiful adaptation between continuous circular and alternating rectilinear motion. We do not feel so much disposed to magnify the ingenuity displayed, in the invention or discovery of these and similar combinations, as to admire the suitability inherent in the things themselves. While we wish to see ingenuity duly rewarded, we do not like the exclusive claim often put forward to the use of principles which ought to be left patent, and not constituted so; principles which are rather to be regarded as founded on the constitution of the human mind, or as the catholic boon of nature to the human race, than as the peculiar offspring of this or the other set of brains. For our own part we should as soon think of Pythagoras monopolizing the 47th of the 1st book of Euclid, or Dr. Herschel patenting the Georgium Sidus, as acquiesce in the fairness of any mechanician challenging exclusive property in the crank.

There is another phase of the reciprocation fallacy, more plausible than any we have yet mentioned, and which continues to prevail even among engineers of respectable attainments. It is, that in pumping engines there is a great loss of effect, in consequence of the alternate rest and motion of the water in the pumps. The water, it is contended, is put into motion at a great expense of power, which power, it is alleged, is lost, when the motion of the bucket ceases. But the power is *not* lost, for the water will not cease to flow when the pump bucket comes to a state of rest, but will raise the bucket valves, and continue to flow upwards by its own momentum, until it has reached a height corresponding to the force originally imparted. In the Cornish, or any other pumping-engines, where the height of the column is considerable, this action is plainly observable, the water in every case continuing to flow from the pump *after* the completion of the stroke.

ART. III.—DURHAM JUNCTION VIADUCT.

PLATE XXIII represents the mode of constructing the trusses for the centring of this truly magnificent bridge. Its great height, and the large span of its arches, render it a work of art unequalled in grandeur by any other bridge in the United Kingdom. There are four large arches, and six smaller ones. Their total length, including the piers and abutments, is upwards of 810 feet; and the height from the base of the centre pier to the top of the parapet, about 158 feet. The arch which is thrown over the river is 160 feet span, forming nearly a semi-circle. There is another 144 feet, and two others 100 feet each. The bridge terminates at each end by three smaller arches.

The centres for the principal arches consist of six trusses to each centre, supported by frame-work built upon piles driven down to the solid rock. The upper part of the centres were formed with movable segments, which, by means of wedges, were adjusted and removed without any difficulty.

The advantage of this method of lowering, or what is called striking the centres in segmental portions, is obvious. It affords great facility in giving to the arch a gradual consolidation, by partially relieving the centre of its weight as soon as the key-stones of the arch are closed, by slackening back the wedges.

ART. IV.—ON THE HEALTH OF THE WORKING CLASSES IN LARGE TOWNS.

No. 1.

To improve the condition of the working classes of our countrymen, and especially of that subdivision of them whose manual dexterity and constructive skill entitle them to the denomination of Artizans; to raise them in the moral scale, and to make them conscious both of their capabilities and duties; to improve their social comforts, and, by diminishing the causes of disease among them, to lengthen their lives and increase their usefulness,—is a duty suggested not only by the common sentiments of humanity, but by the soundest principles of economical science—the object of which is to produce, from a given population, the *greatest possible amount of labour and capital consistent with the happiness of the whole.* We find, accordingly, that in Austria and France, as well as in England, the respective legislative bodies of those countries have set inquiries on foot for the purpose of investigating the physical evils incidental to the industrial population, with the intention that effectual remedies may be applied for increasing their comfort, happiness, and respectability, as well as of merely prolonging their existence. The system of inspection that has been recently adopted with reference to the factories in the British empire, the inquiries of the Children's Employment Commission, and of the Commission for inquiring into the Health of Towns, are all calculated to promote this desirable object; and we think that a few of our pages will not be misappropriated in apprising those who are principally interested in the subject of the nature and extent of various serious evils from which they still suffer, and which may best be removed by their combined exertions. We allude more particularly to deficiencies of ventilation in the workshops and houses occupied by the humbler classes in our large towns, and that absence of sewers, drains, and water-supplies, which leads unavoidably to discomfort and impurity—generating, on the one hand, countless epidemic diseases, and, on the other, blunting the moral sensibilities by the constant violation of decorum inseparable from the inconveniency of a crowded habitation. The same causes, which have ere now depopulated our ships, our gaols, and our hospitals, and which, a few centuries back, visited us like pestilences, often *decimating*, and sometimes *carrying off a fourth* of the population, are still, though in a less degree, actively at work, impairing the vital energies, and abridging the term of man's existence in the great centres of national industry.

The peculiarly emaciated and unhealthy appearance that none can fail to remark in the factory population of Lancashire and Yorkshire, had induced the belief that factory labour, conducted on a large scale in vast establishments, had *of itself* an injurious tendency, and was productive of scrofula, rickets, and other diseases indicating an unhealthy state of the general frame. Indeed, so strong a hold had this notion obtained of the public mind, that a bill was introduced into the House of Commons by the late Mr. Sadler, in 1830, and a Committee of Inquiry appointed for inquiring into the factory system; and a great mass of evidence was brought forward by medical men and others, calculated to bring it into great discredit. So strong was the feeling created, and so apparently distressing were the facts elicited with reference to the usage of the work-people by their employers, that an Act was precipitately passed for regulating the working hours of children in factories. This Act was a modification of Mr. Sadler's well-known *Ten hours' Bill.*

It is useless now to inquire into the motives that gave rise to the gross exaggerations and blundering statements made before Mr. Sadler's committee; but that such misstatements and exaggerations were made during the inquiry, is abundantly proved by comparing that evidence with the other and less prejudiced evidence published in the Report of the Factory Commissioners. The result has proved, that although there are certain objections on the point of health to the factory system, and particularly to the employment of young children during an unreasonable length of time together, yet the factory population is not, *by reason of its employment*, worse conditioned than the handloom weavers and other *domestic* labourers,—that all equally suffer from deficiencies of home comforts, and that in rural districts the work-people of well-conducted factories are more healthy and better conditioned in most respects than any in-door labourers whatever. The truth of this position is made abundantly clear by the comparative table of mortality given in a subsequent part of the article; for, if the factory system had *of itself* exerted a baneful influence on the labourers, the amount of vitality would be depressed according to some definite rule in factory towns; whereas, on the contrary, we find the mortality in Rochdale and Bury fully one-third lower than Manchester; Bradford and Hull nearly on a par; Derby, Huddersfield, and Blackburn, as healthy as Bath or Brighton; and Halifax as healthy as the rural districts. In addition to this, we refer to the mills of Messrs. Gott, at Leeds; Ashworth, at Turton, near Bolton; M'Connell, at Manchester; and Strutt, at Derby;—the Report of Villermé on the health of the working classes in the factory towns of France; and the valuable Report, by Von Pacher, on the cotton factories in the neighbourhood of Vienna;—all afford evidence which makes it clear to the unprejudiced observer, that by far the majority of the evils alleged as *belonging to factory labour* ought, in truth, to be ascribed to the *want of domestic comforts* and necessaries; and that, where these are provided, the health and efficiency of the work-people are in general well maintained; the chief evil being a high mortality among children under two years of age, owing to the absence of mothers from their domestic duties while employed in the factories. This circumstance makes it desirable that females having children under one year of age should be prevented *by law* from resorting to factory labour. As regards the factory employers, we are able to say, from long experience and personal knowledge, that they have provided far greater comforts for their work-people, *when at work*, than any other set of employers. If we compare the sanitary arrangements of a cotton-mill with those of the workshops of the cutlers, hardware-men, and silver-platers of Birmingham and Sheffield, the carpet-weavers of Kidderminster and Scotland, or the book-binders, printers, master tailors, stay-makers, and milliners, of London, we shall find no difficulty in determining on which side the advantage lies: yet against none of those trades has there been any loud or general outcry. We do not, however, say that there ought not to be any; nor do we say that even in cotton factories there are no evils which remain to be redressed. On the contrary, we think the state of the workshops throughout the country should be inquired into by the Government, with the view of compelling those masters, upon whom no mere consideration of humanity will be influential, to adopt such arrangements of ventilation and warming as will conduce to the health and comfort of the persons they employ; and we are not of the opinion which some entertain, that the artizans are so influenced by old habits and prejudices as to resist humane efforts on the part of employers to increase their comforts, and generally ameliorate their condition.

Less than a dozen years ago, and before statistics had been formed into a regular science, it seemed to be tacitly agreed on by intelligent observers that the health of the population of towns was materially worse than that of rural districts. We believe, however, that, till the Registrar-General worked up his facts into argument, and the Poor Law Commissioners published their digest of information respecting the health of the pauper population, no true conception had been arrived at, of the degree in which life, and particularly early life, is affected by the employments of cities. An inspection, indeed, of the grave-stones and parish registers in large towns and country villages respectively, might have led to a well-founded conclusion that a rural labourer in Devonshire would be more likely to attain the age of eighty, than an artizan in Birmingham to reach three-score; but nothing short of the very accurate returns furnished by the annual registration of births and deaths in numerous divisions in England and Wales, and the copious facts furnished by the relieving officers of Unions, could have supplied the data for ascertaining that, while the deaths in the rural counties are under 2 per cent. of the population, or 1 in about 53 persons, the deaths in Manchester are as 1 in 30; and that, whereas the average life of the gentry in rural districts (*reckoning all persons born*) reaches 52 years, 46 years among farmers, and 37 years among labourers,—the term of life in Leeds, for instance, attained by these parties respectively, is only 49, 38, and 21 years. These facts are more clearly shown in the following table:—

Districts.	Average of Life.			Area in square miles.	Inhabitants to square mile.	Annual Mortality.	Deaths per cent. under 5.	Deaths per cent. above 70.
	Gentry.	Farmers.	Labourers.					
1. Country Districts.	48	42	35	17254	206	1 in 54·9	20	20
2. Town Districts.	43	28	20	747	5054	1 in 38·2	35	9
England and Wales.	45½	36	29	57805	265	1 in 46	26	14

It will hence be seen, that the total mortality of the *town* districts (which from the mode of registration, includes also a portion of rural population) is nearly two-thirds higher in town than in the *country*, that the mortality among children is as three and a half in the former to two in the latter; and that whereas in the country eighteen or twenty out of 100 attain the age of seventy, only nine, and those exclusively of the higher classes, reach it in towns; and, lastly, that *the lives of the labouring classes are abridged at least one-third by a residence in the close pent-up purlieus of populous districts.* Now, if the increased rate of mortality were owing to the simple fact of town residence, it would be a lamentable discovery, the more unwelcome, because no remedy would be at hand; but, if we can show that the rate of mortality varies in different towns, and that certain diseases prevail in some towns, and not in others, we shall have proved satisfactorily that there are conditions under which disease, and death, are more or less quickly propagated—conditions, the ordering of which are to a great extent under man's control, and that the higher mortality of towns is due to other causes than a mere proximity of houses. The varying rate of mortality in different towns is well exhibited in the annexed Table, comprising the average annual mortality for a period of five years, of thirty principal towns of England and Scotland.

Towns.—Districts.	Population.—1841.	Deaths.
Metropolis average	1,870,727	1 in 39·39
Healthy parishes W.	241,000	1 ,, 45·66
Unhealthy parishes E.	229,420	1 ,, 30·6
Liverpool (parish)	223,054	1 ,, 28·75
Healthy quarters	....	1 ,, 41·62
Unhealthy ditto	....	1 ,, 25·46
Manchester and Salford	262,636	1 ,, 30·9
Healthy quarters	....	1 ,, 44·3
Unhealthy ditto	....	1 ,, 26·8
Newcastle and Gateshead	110,597	1 ,, 31·26
Sheffield	85,076	1 ,, 33·5
Bristol	64,298	1 ,, 33·75
Oldham and Ashton	130,381	1 ,, 34·6
Bradford	132,164	1 ,, 34·99
Hull	41,130	1 ,, 35·61
Nottingham	53,080	1 ,, 36·8
Norwich	61,846	1 ,, 37·2
Macclesfield	56,018	1 ,, 37·6
Birmingham	138,187	1 ,, 38
Leeds (parish)	168,667	1 ,, 38·09
Rochdale	60,577	1 ,, 38·28
Bury	77,496	1 ,, 38·32
Huddersfield	107,140	1 ,, 40·15
Blackburn	75,091	1 ,, 40·3
Derby	35,015	1 ,, 40·32
Bath	69,232	1 ,, 40·9
Plymouth	36,527	1 ,, 43·7
Portsmouth	53,036	1 ,, 44·6
Brighton	46,742	1 ,, 46·5
Halifax	109,175	1 ,, 48·18
Glasgow	264,010	1 in 31·17
Edinburgh	137,986	1 ,, 35·65
Leith	28,372	1 ,, 38·02
Perth	19,435	1 ,, 41·31
Dundee	59,691	1 ,, 41·48
Aberdeen	63,366	1 ,, 50·59

From the above statements, referring to a considerable number of English and Scotch towns, it will be seen that not only in different towns, but in different districts of the same towns, the amount of mortality is extremely variable; and, it is impossible to conceive that such an amount of variation could have arisen simply from locality in point of the surrounding neighbourhood. In fact, we are in possession of information respecting the domestic and sanatory condition of the inhabitants in all these towns, that enables us to assert with confidence, that the high mortality of Liverpool, Manchester, and Glasgow, is owing to the prevalence of filthy courts and streets, and the want of sewers, water pipes, and other means of purification; and likewise that the mortality varies in all the above towns with the degree of airiness, cleanliness, and respectability of the dwellings occupied by the working classes in each.

These allegations we shall endeavour to substantiate on a subsequent occasion; but enough has now been already said to prove the incalculable importance of the subject on which we have entered. Meanwhile, let us observe, that the Commissioners for inquiring into the Health of Towns have gone forth into the provinces on their mission of benevolence; and we conjure our readers, the artizans of England, by all that is dear to them—by their own lives and health, and that of their wives and families, to give force to the efforts of these good men to raise them from their present degradation, and add to their respectability and comfort. Let them reflect on the vast influence, not on their health alone, but on their characters and prosperity, exercised by the condition of their homes; and let them resolve that no efforts of theirs, at least, shall be wanting to extirpate evils which prey upon their own best energies, and annually send thousands of artizans to an unhonoured and untimely grave.

Art. V.—THE APPLICATION OF GUNPOWDER IN ENGINEERING.

The recent applications, on the works of the South-Eastern Railway, of the force of gunpowder for the removal of entire cliffs, and the nice adjustment in those operations of the power employed to the work to be done, so as to avoid the usual violent effects of gunpowder explosions, have shown that this energetic agent may, by proper management, be employed, in certain circumstances, as safely as most other moving powers. A consideration of the sources whence the force of gunpowder is derived, and of the causes of its effects, will also show that it is capable of being controlled, and is susceptible of being estimated so as to ascertain the amount of resistance the explosive effort of gunpowder can overcome.

Many experiments were instituted by Mr. Robins, with a view to determine the force of gunpowder; the results of which were, that the power exerted at the moment of ignition depends on the generation of a quantity of gas by the combustion of the gunpowder, and on the expansion of that gas by heat. The ratio of the bulk of the gas generated, to that of the gunpowder used, he determined by various experiments to be as 1 to 244; the powder used being that from the Government mills; 17 drachms of which, when well shaken together, occupied two cubic inches. These results, as regards the quantity of gas generated, have been confirmed by subsequent experiments, and, in determining that question, there is not much difficulty; but it is by no means an easy matter to ascertain the amount of expansion of the gas by heat at the instant of its generation. Mr. Robins assumed that the flame of fired gunpowder is not less hot than iron when heated cherry red; and allowing the expansion of the generated gases by heat to be the same as that of atmospheric air, he calculated that the 244 cubic inches of gas generated from one cubic inch of gunpowder would, at the moment of firing, be expanded into 1000; and, therefore, that the force generated by one cubic inch of gunpowder is equal to the pressure of 1000 atmospheres, or to upwards of six tons on the square inch. The amount of expansion by heat must, however, be a variable quantity, depending on circumstances, and on the weight of gunpowder fired; for it may be presumed, as Mr. Robins observes, that, "according to the quantity of powder fired together, the flame may have all the different degrees from a languid red heat to that sufficient for the vitrification (fusion?) of metals." To this variation in the expansion of the generated gases may in part be attributed the varying estimates of the force of gunpowder which have been made by different experimenters; but the difference in some instances is so excessive, that it is difficult to account for it on the supposition of varying experimental results alone. For example, whilst Mr. Robins calculates the force at 1000 atmospheres, John Bernouilli estimates it at but 100; Dr. Hutton at 2000, Dulacy at 4000, Amontons at 5000, Daniel Bernouilli at 10,000, and Count Rumford states it to be not less than 54,750 atmospheres! The late Dr. Maculloch conceived the estimate of Dr. Hutton to be nearest the truth; but as the specific force increases with the quantity fired, it is evident that no fixed standard can be attained, and that the results of practice alone can be relied on.

But even were it possible to obtain a steady guide to the amount of propulsive effort of any given quantity of gunpowder, we should still be far from arriving at an accurate knowledge of the effects to be produced in engineering operations by its explosion in differing circumstances; for the nature of the resistance to be overcome, forms, of course, as essential an element in the calculation as the amount of force employed. In Mr. Cubitt's operations on the chalk-cliffs at Dover, we understand that the rule he observed was to cube the line of least resistance, and to allow half an ounce of gunpowder for each cubic foot of chalk. In military engineering, the quantities which have been recommended are—for loose earth, ten pounds of gunpowder for each cubic fathom; for firm earth and strong sand, twelve pounds; clayey earth, fifteen pounds; new masonry, not strongly bound, about eighteen pounds; and for old, firmly-bound masonry, about twenty-seven pounds the cubic fathom. Each of the latter quantities, it will be observed, far exceeds the proportions used by Mr. Cubitt for chalk; and the success which attended the blasting of the Round Down and the Abbot's Cliffs, will, no doubt, cause those operations to be considered as guides in future similar undertakings.

There can be little question that, in most instances, it has been common to employ much more explosive force than was necessary to overcome the resistance. The loud explosions which accompany nearly every blast, and the propulsion of the fragments of rock to great distances, indicate clearly enough that an excess of force has been employed. This waste of power not only involves useless expenditure of gunpowder, and is attended with great danger to the workmen, but it also greatly diminishes the desired effects. To assert that the disruptive effects of any power may be diminished by increasing its force, seems paradoxical; but it is nevertheless mathematically and practically true, not only in the explosive efforts of gunpowder, but in the action of other energetic powers. It is well known, for example, that a bullet propelled with great velocity will pass through a pane of glass, and leave merely a hole, without shattering other parts of the glass; but if the bullet be thrown with less velocity, the pane will be broken to pieces. Upon the same principle, when the charge of gunpowder is great, the suddenly-generated and expanded gas forces a passage directly in the line of least resistance, and escapes into the air with a loud report, propelling the portion of rock which immediately resisted the force to a great distance. The action of ignited gunpowder, like that of other forces emanating from a centre, radiates in all directions. The more deeply seated is the force, the more extended will be its sphere of action; and, unless it be so powerful and energetic as to overcome the attraction of cohesion directly in the line of least resistance, the propulsive effort will be exerted in directions radiating from the centre of the force towards the outer surface, and will rend and carry outwards a large mass of the resisting rock. When the charge is placed within a short space from the surface, only a small portion of the rock or earth is removed; and when the charge is deeper seated, but too great, the same effect ensues; and in either case, instead of a large mass of rock being severed without explosion, a number of small fragments are blown out with a report as loud as that of a cannon.

We have hitherto considered gunpowder as a compound of unvarying quality, from which, under similar circumstances, the same amount of force may be obtained; but, in fact, this uniformity can only be found in the gunpowder manufactured in the Government mills. The proportions of the materials used in making that powder, are, nitre 75, sulphur 10, charcoal 15. It is customary, in the manufacture of gunpowder for sale, to diminish the quantity of nitre, the most expensive of the materials, and to put a proportionately larger quantity of charcoal and sulphur. By this means the strength of the gunpowder is greatly diminished; and, for fire-arms, it is consequently much less serviceable than the Government powder; but, for mining purposes, this deterioration in strength is considered advantageous, owing to the circumstances we have already indicated. It has been proposed by good authorities on this subject, that gunpowder should be manufactured of various strengths according to the purposes for which it is required; though we doubt much whether a modification in the use of the best powder would not, for mining operations at least, be found preferable to the proposed reduction of strength. Some miners, indeed, pursue the plan of adulterating the gunpowder with sawdust or quicklime, by which means they increase its effect by diminishing its force. The same purpose might, however, be gained by allowing more space for the expansion of the gases generated by the explosion of the powder. The plan of tamping with loose sand has been found far preferable, on many accounts, to ramming up the hole with pieces of rock or other hard substances; but the efficacy of such tamping depends upon leaving a space between the powder and the wadding. To enlarge the chamber wherein the gunpowder is placed produces the same effect as to increase the space it occupies by adulteration: in either case the action is diffused over a larger area, and a larger mass of rock is removed with less violence. It must be borne in mind, also, that as one great source of the force of gunpowder arises from the heat generated in its rapid ignition, if the ignition be rendered more slow by adulteration, the expansion of the generated gases will be thereby diminished; and the suddenness of the action, on which much of the explosive effects of gunpowder depend, will be retarded.

A notion generally prevails, that the force of gunpowder is increased by ramming it hard; and, in the case of fire-arms, it is true that the ball is propelled farther when it is rammed close to the charge; but this is in consequence of the ball being, by that means, placed nearer to the centre of the radiating force. So far from the effect of the powder being increased by ramming, it is necessary to provide for the accession of air to the particles to ensure its simultaneous ignition; and for that purpose the powder is granulated. When the charge in a gun is rammed hard, a great portion of the powder is blown out without being ignited; and powder may be rammed so tight in a small tube, that, on being ignited at the end, it will burn as a squib instead of exploding.

The gradual discharge of rammed gunpowder suggests the possibility of applying its force as a moving power to machinery; but all attempts of this kind must be attended with great danger; and, excepting in some peculiar cases, where great force is required within small compass and weight, the expense would be an insurmountable barrier to its use as a moving power. If we assume, with Dr. Hutton, the force of fired gunpowder to be equal to 2000 atmospheres, then the "duty" of one cubic inch of that agent would little exceed the duty of one cubic foot of steam of the pressure of the atmosphere; and one cubic inch of water converted into steam would exert a steady propulsive effort equal to one cubic inch of fired gunpowder. This comparison of the forces of *fired water* and fired gunpowder shows that little advantage can ever be gained by the use of the latter as a power to propel machinery. It is only when *percussive action* is required to overcome a stationary resistance that gunpowder can be available in the hands of the engineer. The immense advantage, however, which percussive action affords in many instances in overcoming obstacles which a steady force could by no means remove, renders gunpowder a valuable agent in numerous operations; and its application in such cases may be capable of further extension. It seems not improbable, for example, that the tedious process of pile-driving may be greatly expedited by applying, for that purpose, the instantaneous force of gunpowder instead of the accumulated force of gravitation.

The recent successful applications of gunpowder on the South-Eastern Railway at Dover, will, there is little doubt, be the means of bringing this energetic agent into more general use in engineering operations. More attention will also be paid to the adjustment of the quantities of gunpowder to the resistance to be overcome, and also to the mode of tamping the charge, so that its force may have room to expand, and not be exerted on a comparatively small area, and uselessly and dangerously wasted in hurling fragments of rock to great distances from the mine. It is the concussion of the fired gunpowder with the air that produces the report which usually accompanies its explosion; therefore the report is itself an indication of the waste of power in blasting, where the objects aimed at are to rend away as much rock as possible with the least quantity of gunpowder and the smallest personal risk. The loud explosion, and the volley of fragments propelled at each blast, as the operation is at present generally conducted, show that those desirable conditions are as yet far from being attained.

Art. VI.—STEAM-ENGINE PISTONS.

BEING PRINCIPALLY THOSE OF MARINE ENGINES.

In continuing our remarks on this subject we must first be guilty of the irregularity of referring back our readers to the plate of pistons given in our sixth Number, where figs. 10 and 15 represent varieties of packing manufactured by Messrs. Maxton and Co., Leith. The first embodies an improvement, introduced or patented several years ago by Mr. M'Dowall, of Johnston, near Paisley, and consists in cutting the rings in a slanting instead of a perpendicular direction. In Mr. M'Dowall's piston the ring is cut into several segments; and, as only a single ring is used, a sliding piece is cheeked in on one side, to break bond, and prevent the passage of the steam through the opening. We prefer this to the method before described of a mortised sliding piece. That shown in the figure would be improved by the substitution of a single ring of sufficient depth, instead of two; and, by employing a sliding piece behind the joining, thus rendering the hempen packing unnecessary. The other forms of joining shown in the above figures are possessed of no particular interest, being somewhat difficult in execution, without corresponding advantage.

Fig. 11 represents the packing-rings of Stephenson's locomotive piston, as we have seen them used on the Great Western Railway. The peculiarity of this consists in the two rings being grooved and tongued into each other in a manner similar to common flooring-deals. In the published description of this locomotive we are told that this is intended to "keep them steady,"—an end that should, we think, be sufficiently accomplished by their being enclosed within the cylinder. We can scarcely trust ourselves to speak with composure of such a puerile contrivance.

Fig. 12 represents the plan of a piston used on the South-Western Railway, bearing a considerable resemblance to what we have seen on the Liverpool and Manchester line. It is superior in simplicity, and at least equal in efficiency, to several of those we have figured. A modification of this kind is used with success upon the Runcorn Gap Railway, with this difference, that, opposite the set-screw, the ring is made perfectly flat for about the fourth of the circumference.

Fig. 13 represents an arrangement that was extensively adopted by Messrs. Claud, Girdwood, and Co. The packing consists of four rings, from ¾ to 1¼ square, according to the size of the cylinder, which may vary from 6 to 50 inches in diameter. In pistons of the latter dimensions the rings are turned fully two inches more in diameter, and afterwards cut in one place, and bent to the proper circle in a mould prepared for the purpose—the ends being half cheeked in such a way as to be steam-tight without the necessity of using packing behind, which, however, is frequently added. In order to bring the cylindrical surface of the rings sooner to an exact bearing, a groove is turned out of the outer circumference of each: this may help, besides, to keep the piston tight, by affording a lodgment for oil and tallow, and may in certain circumstances be of considerable use. In one instance within our knowledge this kind of piston has been at work, with occasional interruption, but little or no repair, for a period of ten years.

Fig. 14 represents the piston previously alluded to as being adopted on the Glasgow and Ayr Railway, where it has superseded the more complex varieties. Having already expressed our opinion of it at some length, we only add, that it is free from all or most of the defects we have pointed out, and has given much satisfaction in practice. The position of the rings, in being placed with the breaks, 90° apart instead of 180°, is one of those trivial but judicious arrangements which often determines the value or inutility of a mechanical contrivance.

Fig. 16 is a plan and section of piston similar to that used for the American or Bogie engine, as recently manufactured for the Gloucester and Birmingham Railway, by Messrs. Nasmyth, Gaskell, and Co. Two packing-rings, ¾in. × 1¾in., each in three segments, pressed out by three elliptical springs with set screws, through the medium of an inner ring equal in depth to the two, and cut in three places. There is no particular absurdity in this plan. Mr. Nasmyth has constructed many of his locomotive pistons with spiral steel springs instead of the usual elliptical kind: they were found very liable to break, however, and are now almost entirely disused. We have seen hollow packing-rings constructed by Mr. Nasmyth, with the object, we presume, of obtaining a broad steam-tight bearing without increased weight: we are not sure that this is any advantage in them.

Fig. 17 represents Jessop's spiral metallic packing, as made several years ago by Messrs. Claud, Girdwood, and Co., for two small subsidiary engines for the "Don Juan." We have scarcely data for judging of their performance. On considering the action of the spiral coils, when the ring is compressed into a lesser diameter, it will be found that the tension of the springs is a minimum at the centre of the coil; while it increases towards each extremity in the ratio of half the number of coils to unity.

Having thus disposed of the more prominent varieties of land and locomotive pistons, we shall now proceed to say something of the principal forms adopted by the more eminent manufacturers of marine engines.

Fig. 1, Plate XXIV, represents a form of marine piston manufactured by Messrs. Fawcett and Preston. It bears a considerable resemblance to Forester's locomotive piston, sharing both in its merits and its defects. To enter into a detailed analysis of it would be superfluous, after having considered so much at length the general principles by which our judgment has been regulated.

Fig. 2 represents the piston of the "Great Liverpool." There are two packing-rings, each cut in one place, with V wedge pressing out, and tending to expand the ring. This arrangement is nearly identical with that shown in fig. 12, already noticed, and, with a very true cylinder and a sufficiently strong spring, its action will be satisfactory. A powerful horse-shoe spring is, we consider, superior in this case to either a spiral or elliptical spring, and decidedly preferable to the method of pressing forward the wedge by a rigid screw tapped into the piston.

Fig. 3 is the form of piston adopted by Mr. Robert Napier in many of his vessels, being similar to that used in the Cunard, or Halifax line of packets. The peculiar shape of the blocks against which the springs press, instead of the usual V wedge, is one point of difference between this and fig. 6 in the former plate, which it otherwise resembles.

Fig. 4 represents the form of piston at present constructed by Mr. Robert Napier. Two rings, about 2¼in. square, (cylinder being 65in. diameter,) divided into two segments, the lengths of which may be in the proportion of 1 : 5, each ring being pressed out with a number of springs, generally made very stiff, and of little compass: the rings, in consequence, wear so rapidly, that we have known them to require to be eked with a considerable thickness of copper at the ends. We do not know the object of dividing the segments in the above proportion, unless it be to take out the rings without taking off the cross-head: in other respects a single break would be quite as efficient. The distinguishing feature of this piston lies in the cut, on the outer circumference of the rings, being made at a considerable angle with the perpendicular; while that on the inner side is vertical: an arrangement that we do not recollect to have met with before. The peculiar form of spring shown here is, so far as we have observed, adopted almost exclusively by Mr. Napier.

Fig. 5 represents the piston of the "William Fawcett" steamer, the packing-ring of which was made by the Messrs. Seaward. Only one packing-ring is used, about 3¾in. × 1¾in.; sprung in from a larger diameter, or hammered internally so as to have considerable elasticity. This ring is cut in only one place, and a piece, 8in. or 9in. in length, half the thickness, and about one-third the depth of the ring, is checked in on the upper side, in order to break bond; and at the back of the joint a block is placed, screwed to the one end of the ring and loose at the other, so as to prevent the steam from passing through the cut. In addition to the elasticity of the ring, it is pressed out by six elliptical springs. This is, on the whole, one of the best marine pistons we have met with. The ring, however, in wearing, deranges the joint between the ring and the small segment-piece. The joint opens at each end, as shown in the drawing, which is a defect.

Fig. 6 shows plan and section of the piston of the "Don Juan's" engines: (cylinder 68in. diameter.) There are two rings cut into two segments, the lesser being one-third the circumference, with V blocks at the joinings, and slender elliptical springs.

Fig. 7 shows the species of piston employed by Messrs. Miller, Ravenhill, and Co. The ring is turned the full size, measuring to the point of the tongue-piece, and squares are then cut out to allow the ends to come together, so that the tongue-piece is in one piece with the ring. The malleable iron bridle is for the purpose of expanding or contracting the ring, which is effected by driving in one or the other of the cutters.

Fig. 8 represents the marine engine piston of Messrs. Maudslay and Field. Here the tongue-piece is not cast in one with the ring, but is put in with pins; and the slot is on the incline, to prevent a rut in the cylinder. These tongue-pieces, of this and the preceding variety, are of course ground in, and a piece is ground on the back to prevent the steam from passing.

Fig. 9 represents the piston used for Messrs. Maudslay's cylindrical slide-valves. By raising or lowering the screw, it will be evident that the rings are compressed or expanded. A flat place is of course cast in the piston to leave room for the bridle.

The pistons of Messrs. Scott and Sinclair consist of a number of segments pressed out by V blocks acted on by a continuous ring spring. Messrs. Caird's are similar, but the blocks are flat, and the springs are separate. Messrs. Blythe's consist of two eccentric rings, one above the other, without springs or packing. Messrs. Fairbairn and Co. have made several with a double tier of eccentric rings, having eccentric rings again within these, so that the interior of the inner ring is concentric with the exterior of the outer. The space behind the inner rings is also packed with hemp. This variety of piston has been introduced in the "Tagus," but is very troublesome to keep, and has not given satisfaction. Here ends our discourse upon pistons.

ART. VII.—WATCH-MAKING IN SWITZERLAND.

There can be no question that the watch-making trade of France and Switzerland has in recent years much depressed and turned into a greatly narrowed channel the entire clock and watch business of England, which formerly occupied so many good hands in Liverpool and Birmingham,—not to speak of the large population dependent on the art in and about Clerkenwell, in London; and, as respects the public, there is every reason in the world to regret the practice, now so extensive, of importing, often clandestinely, the flimsy and unskilfully made flat-cylinder watches of Parisian or Genevese manufacture, which take the place, without performing the duty, of the sounder and truer time-keepers. As, however, upwards of 25,000 watches of this kind are annually brought over to England, independently of those sent elsewhere, the inquiry is not without interest,—where this industry is carried on, and by what process the art has risen to such extraordinary importance in the French cantons of Switzerland, whence Paris obtains, almost exclusively, its supply of watch-movements and musical-boxes.

The first commencement of the watch-making art in Switzerland is referrible to the early part of the seventeenth century, when a German clock-maker settled at Geneva. In the canton of Neuchatel, however, it arose about fifty years later (by quite an independent process), out of the ingenuity of a skilful mechanic, who, previously unacquainted with watch-mechanism, and called on to repair a watch belonging to a travelled fellow-villager, examined and imitated the movements, successfully repaired the injured article, and conceived the idea of constructing others of similar formation,—making not only the springs and wheels himself, but contriving all the tools necessary for putting his work together. *Knowledge thus obtained under difficulties,*—and a case like this is as much to the point, and as full of encouragement to the humble artizan, as that of a James Watt or a Robert Stephenson,—met with its immediate reward:—a general sensation was excited; rewards were showered thickly on the fortunate inventor; emulation was fired in men of constructive ingenuity to imitate their fellow-countryman; and so, by slow degrees, the art of watch-making took the place of unprofitable rural labour in the secluded hamlets and châlets of the Jura-mountains. We say that the manufacture rose by *slow* degrees; because, at first, the absence of convenient tools and fit materials caused the execution to be extremely slow, and the products as well as profits quite inconsiderable: but in process of time the invention of a great variety of tools, before unknown in the trade, sprung out of the necessities of ingenious men. Very large manufactories of watch-movements, by improved machinery, have been established by Swiss workmen at Fontainemelon and Beaucourt, in the Upper Department of the Rhine; and, at present, the construction of watch-tools has become, at Neuchatel and Geneva, so important a branch of industry, as to give rise, of itself, to a large export trade; whereas, thirty years ago, the same tools, or kind of tools, were, as a matter of necessity, imported at no small cost of duty. The revenue department of the trade, however, was principally benefited by the communication with the wealthy metropolis of France, first set on foot by a few adventurous collectors of watches with very small capital,—scarcely better, perhaps, than the *col-porteurs* or hawkers that perambulate France at the present day; and so great was the success that attended the earliest adventurers, that, in a short time, the great majority of the population embraced one or other among the numerous branches of the watch-making trade; besides which, many of the more ambitious artificers sought in Paris the means of improving themselves in their trade,—some, like the Berthouds, Monnaud, Emery, and Breguet, finally settling there, and acquiring more or less celebrity for their accurate workmanship and ingenious inventions of new machinery; others returning to their native country, in order to advance the art at home by contributions of English and other foreign inventions. And how great an advance the watch-making trade of Switzerland made after the peace of 1815, is proved by the inundation of Swiss watches over all parts of the Continent, the British Empire, and the United States; by the great improvements which the workmen have effected, as well in the interior movements as in the exterior ornaments; by the successful establishment of Swiss workmen in almost all the cities of the known world; and by the spread of the trade from Geneva and the mountain villages of Neuchatel, (especially Locle and Chaux de Fond,) all over the four cantons of Geneva, Berne, Vaud, and Neuchatel, the rural districts of which supply the *ébauches*, or rough movements, which are afterwards perfected at Geneva or Neuchatel.

The higher department of watch-making, more largely pursued at Geneva than elsewhere, is confined to the construction of chronometers, stop-watches and repeaters, simple and complex clocks, timekeepers, &c.; in which the perfection of the machinery is the principal requisite; and articles of this description and make obtain high prices in all the markets to which they can procure an introduction, on account of their intrinsic worth, and faithful performance. The second department, called the watchmaking of commerce (*horlogerie du commerce*) is altogether inferior; and the workmen here pay little regard to the perfection of the movements, but study rather the external beauty of the articles manufactured, which, indeed, are more properly specimens of pretty jewellery than of really good watch-work:—watches of this kind, with a far smaller proportion of the better class, form the staple of the export trade. We may connect with this department, also, the manufacture of cheap repeaters, musical-boxes, rings, seals, &c., as well as large musical automata, often combining correctness and variety of tune, with great external beauty and compactness of arrangement. The large jewellery trade of Geneva, also, is so closely connected with this department that it would be improper to omit all notice of it, especially as Paris itself, once in exclusive possession of the continental markets for jewellery, has become a great depôt for Genevese jewellery, which thence finds its way to England. Italy, however, is the chief mart for Swiss toys and jewellery. It is needless to observe that the watches of the second class are either of very common and flimsy manufacture; or else, if complicated and singular in construction, are so slight and delicate, and of such unsubstantial material, as to do little real service to the purchaser, and from that very circumstance create a constant demand for a showy, but almost useless article. On this account, we are of opinion that the importation of French or Swiss watches will probably inflict much less permanent injury to English watch-makers than is now supposed—as, however great the number may be of persons who value a watch for its merely gay exterior, there will always be among a practical, punctual people, like the business men of England, persons fully alive to the value of good substantial timekeepers.

As respects the number of watches annually made in Switzerland, it would appear, from a comparison of several Swiss authorities in the two principal cantons, that they may be fairly averaged at about 250,000, of which about one half are in gold, the rest either in silver cases, or exported without cases at all;—and the capital engaged in the trade, exclusive of clock and watch-tool making, somewhat exceeds *two millions*, giving employment to about 24,000 watch-artificers, employed by 400 *chefs d'atelier*, or master watch-makers. The annual consumption of gold may average 60,000 oz.; the jewels being valued at 25,000*l.* The wages of the workmen are regulated altogether by their skill, talent, and exertions,—payment being always regulated by the produce of labour; but a good workman may calculate on earning from 60*l.* to 80*l.* a year, which constitutes good wages, considering the frugal, inexpensive habits of the Swiss. The mountain workmen, however, who confine their labours to the inferior departments of the trade, earn little more than half of the sums above mentioned.

The duties on the importation of Swiss watches into France were formerly so high as to be tantamount to a prohibition; the natural consequence of which was the rise of a very large contraband trade, which seriously injured the morals of all the lower orders of people living on either side of the border. The substitution of a duty of 6 per cent. on gold, and 10 per cent. on silver watches, has been productive of great advantages to both countries,—though the smuggler still finds abundant employment, especially in the clandestine removal of watches intended for the English market, which pay a duty of 25 per cent. on importation. In Austria and Sweden, the Swiss watches are altogether prohibited; but hither also they find their way in great numbers; and the high duties imposed on them in Russia and the United States offer no obstacle to their illicit introduction. Such facts as these prove volumes respecting the utter folly of high prohibitive duties, which ever have been, and ever will be found to defeat their own *ends*.

ART. VIII. THE BUILDING ARTS.

CARPENTRY.

WE are at length able to say something upon this important subject; to which, for the future, we shall devote a considerable part of our space. Our purpose is to communicate such sound and practical information, relative to the various building arts, as will aid the workman in the acquisition of their principles, and supply the defects of systematic treatises. It will not be expected, from this definition of our purpose, that we mean ourselves to produce a systematic treatise on any of the building arts: that would involve the repetition of much that has been already said; and we desire our pages to be the depository of that species of information only which cannot be found in any other quarter. Our expositions will, therefore, be confined to points which have come under our own notice in practice, and of which we conceive an elucidation would be useful and acceptable.

Untrussed roofs.—The first subject we shall touch upon is the important subject of roofs; and it may contribute to the better illustration of various points, if we endeavour to trace the various steps by which the existing forms of roofs have reached their present perfection. Fig. 1 shows a very primitive form of roof, still to be met with in antiquated cottages; and which was probably used extensively antecedently to the application of the truss. The timbers of this species of roof reach from the ridge to the ground; but are cut out of bent timbers, so as to afford adequate head-room; and, in form, much resemble the timbers of a ship. The scantling of these timbers varies from ten to twelve inches in width, and from four to six inches in thickness. The material, almost universally, is English oak. They are half-lapped at the top, and secured by oak tree-nails, about one inch in diameter, driven through the joint in dovetail directions. The collar-beam dovetailed, and half lapped into the rafters, is also secured by oak tree-nails. Figs. 2 and 3 show the mode of their execution. The ridge and outlines are made to rest on the projecting ends of the timbers, and are spiked to the same by wrought iron spikes.

The common rafters of oak were usually rent out of the smaller trees by the use of a hammer and iron wedges, each tree being rent into halves or quarters, according to their various sizes. These rafters were generally placed about four inches apart, resting upon the wall at the eaves, and secured to the ridge and purlins by wrought-iron spikes. The interstices were filled in with hazel boughs, in the shape of wicker-work; and the whole way covered with successive layers of straw, reeds, or heather; each layer being fastened to the rafter by boughs of nut-wood and bedding, upon and overlapping the preceding, so as to render the covering impervious to wet. The ridge was finished at the top with a coping of sods, fastened by boughs of nut-wood, and forked down, in a zig-zag position, into the covering beneath.

Such was the form of roofs adopted in the ordinary dwellings of former days. It would appear, that up to this time the use of the tie-beam was unknown; and the absence of tie-beams made the use of stone buttresses indispensable in the larger class of edifices, so as to counteract the thrust of the rafters on the walls.

Roofs with tie-beams.—Figs. 4 and 5 show a description of roof which came into use at a later period, and in which we find the tie-beam introduced, so as to embody, to a certain extent, the principle of the truss.

Figs. 6, 7, and 8, show the mode of joining the parts of this variety of roof.

It will be remarked that the tie-beams here introduced have not only the effect of resisting the strain of the rafters, but also serve the purpose of supporting the floor of a loft or upper room. The ridge piece rests in the angle of the rafters; and the purlins are notched, and spiked to the back of the rafters, as shown by fig. 9.

The common rafters of this species of roof were sawn out of oak timber, in scantlings averaging about four by three inches, and were generally placed about twelve inches apart, their feet resting upon a wall plate at the eaves; and they were firmly nailed thereto, as well as to the purlins and ridge piece. The covering was chiefly composed of layers of grey slates.

These layers of slates were made to rest on laths riven out of oak timber, and fastened thereto by the insertion of the shank-bones of sheep and other animals, through holes formed in the slates for their reception. The slates were so arranged as to joint with each other; and every third layer overlapped the head of the first by about three inches, as shown by fig. 10. The interstices necessary for the clearance of the joint protuberance of the bone were carefully filled in with moss, on which the slates were bedded. The ridge finished at the top by a double row of slates, notched into each other, as shown by fig. 11.

Roofs with king posts.—The next form of truss is that in which the crown or king post is introduced. Among the earliest examples we may notice those used for the low-pitched, lead-covered roofs of churches (fig. 12), in some of which we find the tie-beam is formed of scantlings considerably larger than those of the rafters; the feet of the rafters being housed into the ends of the tie-beam, as shown by fig. 13. The middle of the beam is suspended from the junction of the rafters by the king post; by which means the difficulty arising from the deflection of the tie-beam, owing to the great distance of its bearings, is obviated. It would appear, however, from the bulky dimensions of the tie-beam, that great reliance was placed on the stability of its resistance to vertical pressure; and, in some instances, puncheons were made to rest upon it, for the purpose of counteracting the thrust upon the walls occasioned by the weight of the roof.

The imperfections, however, of this variety of truss, are entirely removed by the variety called the king post truss. The weight of the whole roof, uniformly distributed over its surface, is made to rest upon the bearing points of the tie-beam. This judicious arrangement is effected by placing stints immediately upon the footings formed on each side of the king post. See fig. 14.

Fig 15 shows the original method of securing the tie-beam to the foot of the king post.

This plan has been abandoned in favour of the more efficient method of fastening by means of wrought-iron bolts, as shown by fig. 16; or by wrought stirrup-irons, with gibs and cotters, as shown by fig. 17.

The rafters secured to the tie-beams are shown in fig. 18.

Fig. 19 shows the method adopted in joining the king post with the rafters and struts.

Roofs with queen posts.—Another and more modern method of forming the trusses of roofs, so as to prevent the deflection of the beams in roofs of great magnitude, as well as to give stability to the uniform pressure of the weight of the roof is shown by fig. 20.

In this roof the bearings are more equally divided by the insertion of queen posts and straining beams, the middle of the tie-beam being suspended, at intervals, from the angles of intersection of the straining beams, and the rafters preserved in equilibrium, upon the principal of the arch.

Fig. 21 shows the mode of joining the queen post with the straining beam and principal rafters.

A still more effective mode of preventing any alteration of form in the frame-work of carpentry is, to cause the fibres of the timbers to butt against each other, without the intervention of any compressible material; in which case the rafters and straining beam are brought in contact with each other, a piece of sheet-lead being only interposed between them. On each side of this butt-joint the queen posts are notched and fixed, as shown by fig. 22.

For the further distribution of the weight of large roofs, a method of support in the upper part of the rafters, as well as of increasing the stability to the straining beam, is practised, the nature of which will be understood by a reference to fig. 23. In this case the space between the straining beam and tie-beam is used for rooms the ceilings of which are supported by the straining beam.

Roofs with hip rafters.—In the construction of modern roofs we frequently find the ends of the roof terminating with the same angle of inclination or pitch as that of the sides. When this is wanted to be done, it is necessary to introduce what are called hip rafters, the plane of the rafter forming a mitre by the intersection of the inclined surfaces of the side and end of the roof.

The modes of supporting and giving an equal degree of stability to the hip rafters are various. In small roofs it is sometimes the practice to form a dragon piece, or kind of T-shaped frame-work, which is placed in an angular position upon the corner of the walls. Upon the end of the short arm of this framing the foot of the hip rafter is fixed, the upper ends resting against the king post. To the sides of these hips the ends of the purlins are fitted, and strongly spiked; the upper ends of the common rafters being also similarly fixed thereto. The depth of the hip rafter is of such scantling as to receive the united thicknesses of the purlin and common rafter.

In some roofs a tie-beam is introduced, for the more perfect security of the hip. This beam rests on the angle of the wall at the outer end, its inner end being fixed to the main tie-beam. Its joining therewith is accomplished as shown by fig. 25.

The middle of the hip rafter is supported by a strut from this tie-beam, as shown also by fig. 25.

Fig. 26 shows the mode of joining the beams at their intersections.

In roofs of considerable span it is necessary, for the support of the hip rafters, to introduce truncated trusses.

Figs. 27 and 28 show the disposition of the parts of these trusses. The straining beams, in both cases, serve the purpose of purlins; and the queen posts are usually placed so as to receive the hip rafters, in their direction towards the ridge. The hip rafters are notched, and spiked to the top of the queen posts. To enable our readers to ascertain at once the corresponding heights and position of the several parts of these trusses, we give the following rule for determining these dimensions, which we have found of much use in practice:—

Let A, B, C, D, fig. 29, represent the boundary of the planes formed by the intersection of the upper surfaces of the common rafters upon the surface of the walls, the lines EG, GF, forming the pitch, as conceived to be turned down upon a horizontal plane. The lines KL and MN represent the seats of the truncated trusses, which are so placed as to divide the bearings of the hip rafters into equal parts. A I, B I, DH, and CH, show the seat of the hip rafters intersecting with the planes of the truncated trusses KL and MN, in the points *o*, *p*, *q*, *r*, which gives the centres of each of the queen posts respectively. Then, to find the height of the straining beam from the plane of the feet of the rafters, draw the lines *o d*, *q t*, *r u*, and *p x*, parallel to the lines A D or B C, cutting the lines E F in the points *s t u x*, and the pitch lines of the rafter, E G and G F respectively, in the points *d e f g*. The distances or heights of the lines *s d* and *x g*, in the lower section, and *t e* and *u f*, in the higher section, being thus obtained, deduct from these heights the depth of the common rafter, which leaves the height required for the top of the straining beam.

Then, to find the length of any of the hip rafters, say, that at A I, in the acute angle of the roof:—With the point I as a centre, describe the line A O cutting the line E F, produced in the point O. Draw the line O G, which is the length of the hip required.

Fig. 30 shows the elevation of a truss sometimes adopted for the support of the joisting of lead flats. In the formation of this truss, the principal rafters or struts are formed out of the parts of the beams which are cut away to form the butt joints in the framing. The tie-beam is prevented from bending by the wrought-iron suspension bolts shown in the diagram.

Our limits prevent us from extending this article further, although there are many important points connected with the structure of roofs to which we have been unable to allude. In a future number we shall say something upon the nature and formation of domes and circular roofs. We shall also offer a few general remarks respecting the application of conic sections, and other parts of practical geometry, to this department of building.

MASONRY.

Foundations.—The first step in the construction of any piece of masonry is, to ascertain the nature of the ground on which it is to be placed. In important cases this is done by boring, by which operation the nature of the substrata is made manifest, and the architect is enabled to determine to what depth the foundations should go. In the ordinary class of buildings, however, boring is not resorted to, but foundation trenches are excavated, to the depth of from six to eight feet below the footings, and are filled up, to the level of the footings, with concrete. This concrete is composed of one part of lime, and six parts of gravel and sand, mixed with water to a proper consistency; and it is thrown into the trenches from a height, with a view of bringing about a better consolidation. The trenches should, in all cases, be dug of a sufficient width to afford ample room for working in them; and, as soon as the walls are carried up to the surface of the ground, the earth should be carefully filled in, and well rammed down.

In cases where the building rests upon rock, and is at the same time exposed to a disturbing pressure, such as that of a current against the piers of a bridge, or of the sea beating against a lighthouse or pier, it will generally be proper not merely to make the surface of the rock horizontal, and to take care that the stones are well fitted to it; but to indent the stones a certain distance into the rock, and to form them in dovetail courses, as was done in the case of the Eddystone lighthouse.

In clay foundations it has been considered necessary, where great solidity is required, to lay down beneath the masonry a timber platform, composed of a sufficient number of rows of longitudinal sills, about nine by five inches, and bedded in the clay, over which two layers of three-inch planks, crossing each other, are laid, spiked to one another, and also to the sills. Round the whole of this timber platform a row of four-inch pile planks is driven, the piles being close together, and spiked to the outer rows of sills. The whole of the timber used for this purpose should be of a durable kind, such as Memel or Riga fir, or British oak. Should the nature of the ground be such as not to afford the requisite stability by any of these methods, the platform upon which the masonry is to be supported may be made to rest upon piles driven to such a depth as to reach a firm support. Such piles are usually of Memel, one foot square, and are shod with iron..

In situations where large flat stones can be obtained easily, it is usual to commence the masonry by laying down large flat footing courses, each stone measuring from 12 to 20 feet superficial.

Cements.—In works which are exposed to the action of the sea, or the current of rivers, the late Mr. Rennie adopted the plan of bedding the outside joints, for about an inch deep in the face, with Roman cement, of the best quality. The interior part of the stones was bedded in mortar, composed of two parts of well burnt stone lime, one part of ground puzzolano, or calcined pounded iron stone; and two parts of clean, sharp river sand, not too fine. The lime was used hot, for which purpose it was necessary that it should be burnt adjoining the works, and mixed at once with its due proportion of sand and puzzolano or iron stone, previous to being staked. It was afterwards covered over with sand, so as to prevent the access of the air; water was then poured on the heap, and in this state it was left for a day or two, until completely slaked; after which it was taken from the heap as wanted. The unslaked particles were separated, and the other ingredients well mixed, by being passed through a screen, after which the mixture was made into mortar, with the least possible quantity of water, by means of a pug-mill, prepared for the purpose. That part of it required for the day's use being taken away, the remainder was immediately covered up with sand, to prevent the action of the air upon it.

Walls.—Having thus far explained the mode of laying foundations, and the composition of the commoner building materials, with a greater fulness of detail, probably, than will appear necessary to some of our readers, we shall now proceed to say something respecting the several kinds of walls, and the modes adopted in their construction.

Random Rubble Work.—The most common description of walling is that termed random rubble work; which is chiefly composed of mis-shapen pieces of stone, the size and weight of the pieces being such that a workman may build them into walls without the assistance of machinery. These stones are bedded in mortar, without any other dressing than they receive from the rude manipulations of the hammer. Walls built in this manner are composed of a succession of levelings or tiers of work formed of two or more courses of stone, stacked up to a height not exceeding 18 inches, any protuberance on that side of the stone intended for the face being cut off by the hammer or axe. The interstices arising from the irregularity of the beds are filled with small chippings and mortar, so that the stones may be prevented from joggling. The spaces also between contiguous stones are carefully filled in with stone chippings and mortar up to the top of each stack. Upon this surface bond stones are laid at intervals of about 6 feet from centre to centre, their lengths reaching through the entire thickness of the wall, and thereby serving the purpose of bonds. Upon these bonds, a second tier or leveling is commenced and completed in a similar manner, upon which other bond-stones are placed, and so on until the desired altitude has been attained throughout the whole of the work, so as to distribute their number uniformly.

In cases where the thickness of the walls exceeds 20 inches, or where this description of rubble-work is used, for the hearting or backing of the ashler facing of piers, it is usually composed of one layer or course to each leveling, the stones being carefully pinned in the beds, and well filled with stone chippings and mortar. Each stone rests upon two or more of the others beneath, in a manner which is usually designated as, "bonding with each other, and among themselves," and levelings are formed at or about the height of 5 feet. Upon these an ashler bond course is placed, formed in large flat bedded stones, roughly broached on the beds, each stone consisting of not less than twelve superficial feet. The next tier of rubble-work is built upon this bond course, which is made to cover the entire surface of the rubble-work, as well as the ashler facing.

Coursed Rubble-Work is similar in its character to that of random rubble-work, excepting that greater pains is bestowed upon the formation of even surfaces for the beds, and that each course consists of stones more uniform in height throughout the entire thickness of the wall.

Blocking Course-work is formed of stones from 6 to 9 inches in thickness. Their beds and joints are drafted round with the chisel, and the space between roughly broached with the pick, and knotted over with the chisel, so that the stones may bed fair upon each other. In walls of ordinary thickness, where the hearting or backing consists of rubble-work, with the exterior surface of blocking course, the face is built in courses, consisting of headers and stretchers. No precise rule is given to determine the thickness of this outer face; it is usual, however, to make the joints or beds, not less in the width than in the height of the course, nor less in length of face than twice the height. An apportionment of one-sixth of the superficial face is made to the space necessary for headers, and these are placed at such intervals in each course as to distribute their number equally throughout the whole face of the wall. In the headers as well as stretchers no joint should be allowed to break less than 6 inches.

Ashler-Work is formed of smooth blocks of stone from 10 inches in thickness to any dimension which the nature of the works may require. The beds and joints are worked fair and true, the face being either chiseled, rubbed, or tooled, according to the directions of the architect or engineer. The beds and joints of each stone are made to square through their entire length and width, and the mode of bonding is similar in all respects to that already described for the blocking-course work. It may, however, be observed that in this as well as all other description of masonry, the external angles are formed with quoins placed upon each other, in the direction of the surface of the walls. All openings or apertures are secured at the angles by outbands and inbands placed through the full thickness of the wall. The backing or hearting to this sort of facing, is sometimes composed of blocking-course work, and at other times of ashler-work throughout.

We have now got through the elementary part of this important subject, a consummation for which our readers will, probably, be as thankful as ourselves, for we feel, our expositions must have appeared trivial to many, and tiresome to most. The interest, however, as well as the importance of the subject, will increase as we proceed sufficiently, we trust, to atone for our present verbosity.

Fig. 1.

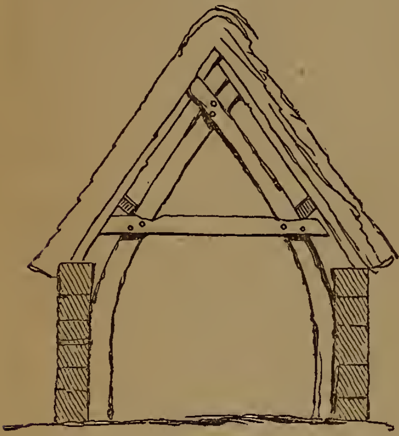
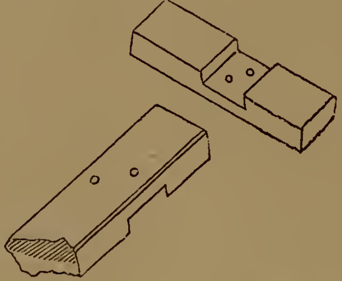


Fig. 2.



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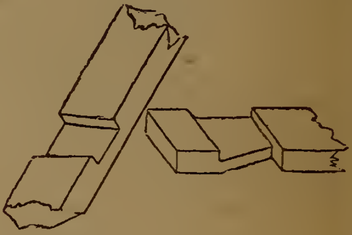

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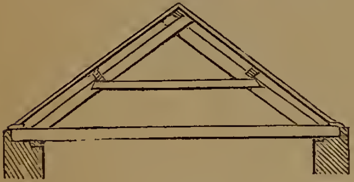

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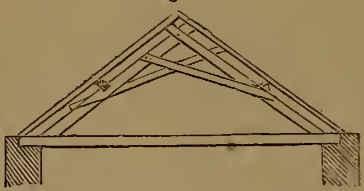

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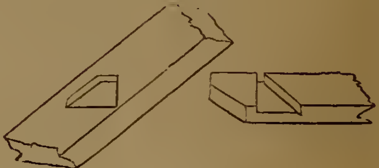

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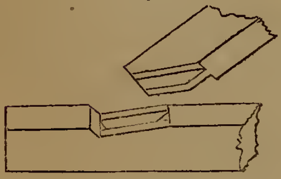

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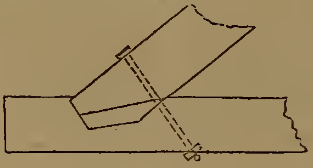

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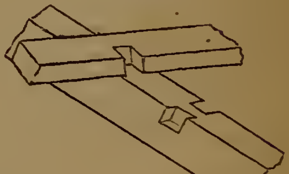
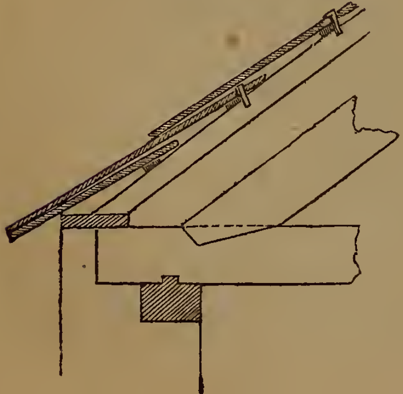


Fig. 10.



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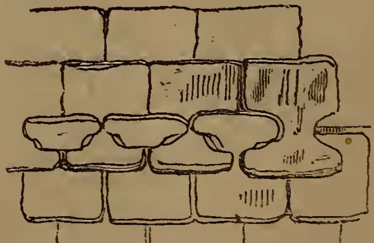

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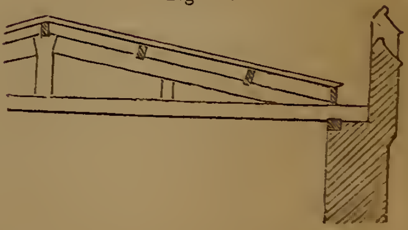

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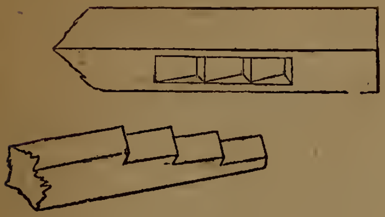

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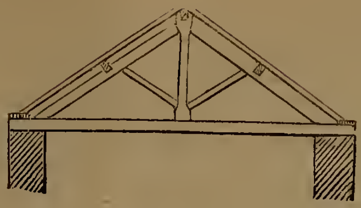

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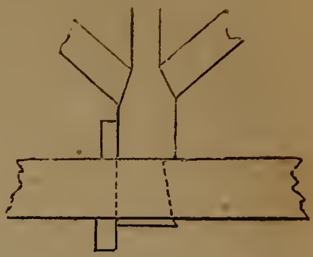

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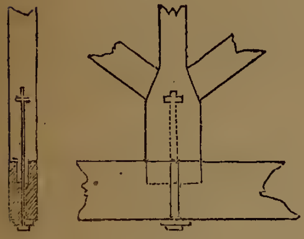

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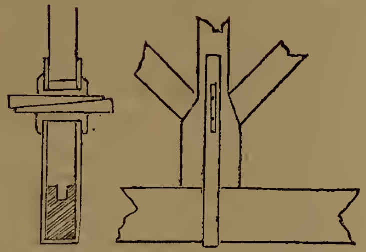

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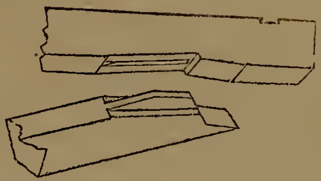

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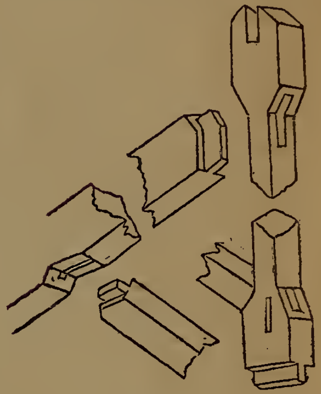

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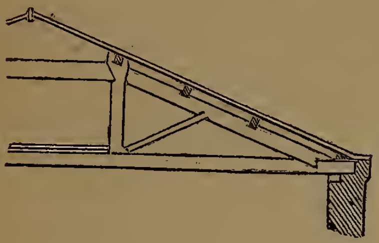

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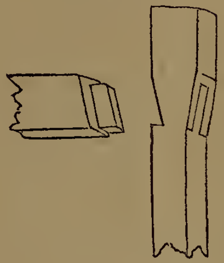

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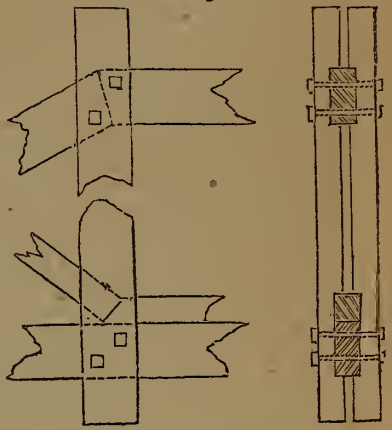

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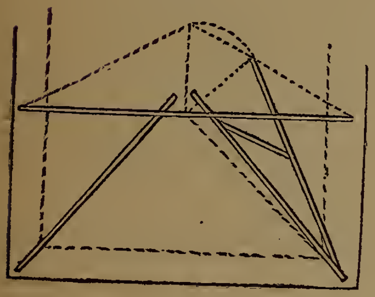

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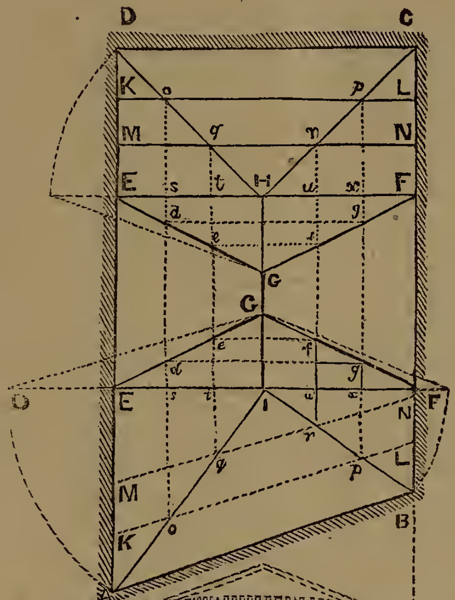

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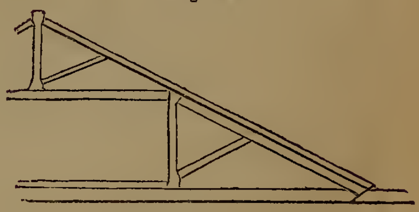

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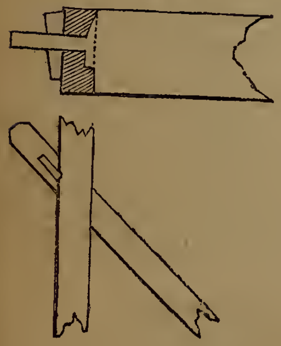

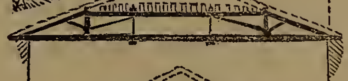

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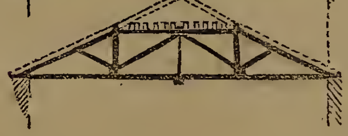

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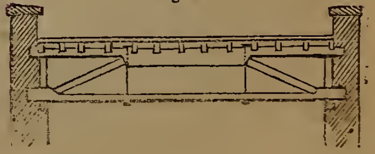

Art. IX.—REMARKS ON CUTTING EMBANKMENTS, AND OTHER EARTHWORKS.

Alteration of Earth when placed in Bank.

In continuation of the remarks on this subject in our last Number, it may be observed that the old canal engineers commonly took into account, in their estimates, the consolidation or compression which all argillaceous earths experience when placed in embankment. It was quite customary with Chapman, Smeaton, Jessop, and the other engineers who flourished in their time, to make an allowance varying from one-twelfth to one-sixth of the whole mass of the embankment.

The great compression of bog-earth has been already alluded to; and it is within the knowledge of the writer, that embankments made from the light oozy peat of Norfolk and Lincolnshire have shrunk into less than one-sixth the space which they measured in the cutting. The Liverpool and Manchester Railway, which passed over several mosses or bogs of considerable extent, has furnished some valuable data on this subject. For instance, over Parr Moss, between the Whiston inclined plane and the valley of the Sankey, there is an embankment four or five feet in height; but it is known that sufficient stuff was deposited in this place to form an embankment twenty-five feet in height. This, however, is not a case of compression; the great apparent alteration of volume being occasioned by the sinking of the embankment through the whole body of the moss. In the neighbourhood of the famous Chat-moss, however, we have a direct example of the excessive squeezability of moss earth. It appears that, on the eastern side of the Moss, between Bury-lane Bridge and Legh's Occupation Bridge, in a distance of 4¾ miles, the embankments amount to about 277,000 cube yards of moss earth, in the construction of which about 677,000 cube yards of raw moss have been employed.*

Facts of this kind may be usefully applied when engineers come before Parliament with absurd estimates for the execution of earthwork. For instance, it would in many cases be perfectly fair and safe to assume even so low a price as 2*d*. per cube yard for cutting out peat and casting it to a considerable distance with a fly tool. This price is applicable to the measurement of the cutting; but if it were attempted to be shown that an embankment to be made up from side-cutting, or in any other way, could be filled at such a price, the fallacy becomes obvious at once, and ought to be exposed.

We have alluded, in a former paper on this subject, to the different degrees of compressibility exhibited by embankments made of the very same stuff, according to the way in which the stuff has been filled. When the material of an embankment is teamed over-head in one deep lift, it commonly occupies at first a much larger bulk than it did in the cutting; and consequently its future settlement will be very considerable. On the other hand, when formed in shallow layers or lifts, not exceeding four feet in depth, and when each successive lift is compressed by carts passing over it, the shrinkage will take place at once, and the embankment will often present its least bulk by the time the work is finished; whereas lofty embankments teamed over-head will take many years to settle. It has happened to the writer to witness very recently a remarkable instance of the different amount of shrinkage which is experienced in embankments, according to the mode in which they have been formed. The instance alluded to is that of some embankments of average size made upon a turnpike-road which runs nearly parallel with the line of an important railway. Some of these embankments were formed from stuff taken out of cuttings on the road itself, and were filled in successive layers by horse and cart. They were made up to a height something greater than the intended permanent level; and on levelling over them now, at a distance of five years after their completion, they are found to have sunk only to a very trifling extent. One or two other embankments, however, or parts of embankments, particularly in the deepest places, were made up from the railway cuttings, by contractors engaged on the railway itself; and their stuff was teamed over-head in one lift, according to the usual practice in railway embankments. The portions thus made were originally formed to the same height as the other parts which experienced little or no shrinkage; but they now present a remarkable difference, the embankments having a hollow in the deepest part three or four feet below the level to which they were intended to be raised, and probably not less than five feet below the height to which they were originally formed. Nor is this all; for we were credibly informed that a great expense had been incurred in filling up the hollows with gravel or metalling, in order to bring the surface up to the intended gradient line; notwithstanding which, the deficiency here described is still existing.

Mr. Telford, whose superior skill in road-making is too well known to require comment, always specified that the embankments should be made in layers not more than four feet in thickness; and, when they were formed of clay, was very particular in requiring that the lumps should be broken and chopped up into small pieces before being placed in embankment.

There is another circumstance in the formation of embankments which affects their compressibility quite as much as the way in which the stuff is teamed. We allude to the season of the year and to the state of the weather at the time when the filling takes place. For example, if clay be filled in the dry months of summer, it will probably be put into the wagons in large masses, and, however much trodden down by horses passing over it, will form an embankment with large vacuities, which will most certainly cause a considerable settlement in future. On the other hand, clay which is filled in a wet plastic state will far more readily be compressed and squeezed together; and if put into embankment in layers, will scarcely measure more at first than its capacity in the cutting; whilst the effect of the water draining out of it will in time bring it into considerably less bulk than it measured in the cutting.

It may be here observed, that although some experiments have been mentioned in the preceding paper which are brought forward by their authors as furnishing the exact amounts of compression in certain cases, yet it is necessary to receive such experiments with great caution; for it often happens that embankments measure less than could be expected—not so much on account of shrinkage as because they have partially sunk into the ground in a way similar to that which has been described when speaking of Parr Moss, on the Liverpool and Manchester Railway. This latter is unquestionably an extreme case, for the embankment appears to have sunk quite through the moss down to the very bottom of it. At the same time there are many similar cases on a smaller scale,—a fact which is perfectly well known to those who have observed the frequent bulging up of the natural ground along the foot of heavy embankments. It appears from this to be very necessary that, whenever a measurement is made to ascertain the compression of an embankment, great care should be taken not to confound the real compression with the loss of quantity caused by the sinking of the whole mass into the ground.

When we consider how defective are the experiments which have hitherto been made on this subject, how various are the opinions entertained upon it even by practical men, and how importantly it affects the economy of railway and canal construction, it is highly necessary that systematic observations should be recorded, for the purpose of affording more certain groundwork for estimating than that which is at present available.

So great is the ignorance which prevails on the subject of compression, even amongst persons of great experience in earthworks, (to say nothing of mere writers and professors of engineering,) that we have ourselves heard practical men declare that no stuff except peat or bog-earth will settle into less bulk in bank than its real measurement in the cutting. The principle on which the assertion has rested is this, that if a small hole be excavated, and the stuff which came out be immediately shoveled in, it will not only fill up the hole, but there will be a considerable surplus. Now this is very true when the experiment is made on a small scale, because the earth, on being filled in, receives no compression either from falling through any height, or from the weight of a considerable depth filled in above it. Hence, when filled in loosely, without pounding or any other mode of compressing being resorted to, it will certainly more than fill the place from which it was taken; but suppose, now, an excavation of considerable depth to be made, and the stuff filled in as before, the result will be very different, because the stuff first filled in will be compressed by every shovel-full thrown in above it, and the compression of each successive layer goes on gradually increasing from the top to the bottom, where, of course, it is greatest. The writer can speak from positive experience, to the fact, that gravel taken from a pit of eight or ten feet deep, and thrown in again, will not nearly fill up the hollow of the pit; and one case particularly occurs to his recollection, where the deficiency was so great as to lead to a strong suspicion that some of the stuff had been clandestinely removed. Subsequent inquiries, however, satisfied all parties concerned that this had not been the case, and that the deficiency was entirely caused by the compression of the material itself.

A very unhappy consequence of the bustle with which railways have been executed is this, that engineers have derived far less experience from them than might have been expected—far less, comparatively, than the preceding generation derived from the more sober progress of the old canals. Let any impartial judge read even the most recent evidence given by engineers before Parliament, and he will most amply recognize the truth of this. The difference in estimates which may be made according to the views which separate persons entertain on the subject, is much greater than the public generally suppose—greater than engineers themselves are willing to admit. Take an example of an embankment, containing 100,000 cube yards, to be made up with peat, which can be excavated and filled, say at 4*d*. per cube yard. The question now is, how many yards of cutting will make up such embankment? Some say that double the quantity of cutting will form the bank; and others go as far as to say that eight times the quantity of cutting will be required. Who shall decide between these two extremes? Probably enough, the advocate of each is quite right with reference to his own experience; for, undoubtedly, there are varieties enough in the composition of peat to justify even wider extremes—some being so heavy and solid as to be in a very small degree compressible at all, and others so soft and spongy that they may be squeezed into at least an eighth of their original bulk. In the case before us, if we assume that eight yards of cutting are required to make one of embankment, it is clear that each cube yard of the latter will cost 2*s*. 8*d*.; and if we suppose the peat compressible into only half its bulk, then each yard will only cost 8*d*., the price in the latter case being only one-fourth of that in the former.

On the means of preventing dangerous settlements.

In forming railway embankments it is usual to raise them at first considerably higher than the permanent is intended to be, in order that the settlement may bring them down to the required level. This method has many obvious disadvantages, since it is impossible to know how long a time will be required for the settlement; and it is equally difficult at any given time to decide whether the embankment has reached its minimum bulk, or whether a further settlement will take place. In order to guard against these uncertainties, some engineers have specified that the stuff shall be filled in shallow layers, or that it shall be chopped and pounded; and in some particular cases of canal or reservoir embankments, it has been directed that the whole shall be puddled. It may probably be asserted with perfect confidence that there is no clay or other material so difficult to deal with as to make it impossible to form an embankment of it which shall at once assume its least bulk. The only question is one of expense with reference to that of expediency. If the case requires expedition, and if the consequences of after-settlement would be very serious, it is possible that an expense almost equal to that of the excavation itself might be justified in adopting measures to effect the immediate settlement of an embankment. Such cases are undoubtedly rare; but there are many instances of public works in which some extra expense may be judiciously incurred with the view of bringing the embankments as speedily as possible into a sound and solid condition. The case of a reservoir to hold water for the supply of a large town, may be cited as one which would justify almost any expense in the formation of embankments which stand at once without any future settlement, because the consequences here of any settlement after the water was admitted would probably comprise not only the loss of all the water, but, possibly enough, the carrying away of a great part of the mound itself.

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* Booth's Account of the Liverpool and Manchester Railway.

The expression "dangerous settlement" assumes a different meaning according to the kind of work which calls for its application. Thus a dangerous settlement in a railway embankment would be, where one side of the bank, that is, one line of rails, sunk down so low as to cause an engine or carriage to upset. In the same manner it would be dangerous in a road embankment, where one side was depressed below the middle to such a degree as to upset carriages. Also in a canal or reservoir embankment, it would be highly dangerous when any settlement took place sufficient to cause the escape of water. Now all these cases of settlement are so intimately connected with the stability of the slopes that they can scarcely be entertained separately from the latter. It commonly happens, in fact, that all those partial settlements which produce danger are accompanied by slipping or bulging of the slopes; otherwise they could scarcely have taken place. Such settlements are, therefore, quite different from that gradual and uniform compression to which the whole mass is subject, and on which we have already remarked at some length. We shall now, then, confine ourselves to the prevention of those partial derangements of an embankment which are commonly occasioned by slips, but are often confounded with real settlement.

It has been already mentioned that the general system of forming railway embankments is to team the stuff over-head in a single lift, however deep the embankment may be. There are some who argue that the object of compressing the stuff is tolerably well effected by this mode of working, since the lumps are a good deal broken by tumbling from top to bottom of the bank, and the lower part is pressed by the whole dead weight of the mass resting upon it. In order further to produce an immediate compression of the stuff, the specification usually directs that the lumps are to be broken up before being filled. Notwithstanding this precaution, however, the experience of all who have been extensively engaged in earth-works plainly points out that it does not effect compression at the time with anything like the same certainty as the method of teaming in shallow lifts of two or three feet in depth. The chief practical objections to this latter plan are, its great expense, and the length of time it would occupy. According to the modern practice of carting stuff to embankments, on wagons which run upon iron rails, it would be an incessant expense, and a most laborious work, to be constantly taking up and re-laying the rails and sleepers upon each successive lift up to the top of a heavy embankment. Hence the far greater economy both of time and money which is realized by working the whole embankment with only one teaming face.

One of the most fertile sources of those frequent slips which have taken place in so many railway embankments, is the mixture of different kinds of stuff in the same bank, or the use, amongst others, of materials which readily admit water, and those which are so far acted on by water as to fall into mud, or to be carried away by it in a state of suspension.

Probably one of the worst mixtures which can be put into a bank is that of sand and clay, one which is more frequently met with than perhaps any other. It so commonly happens that hills of stiff clay are capped by sand or gravel, that we cannot wonder at the constant necessity for making up an embankment partly of one, and partly of the other, out of a cutting composed of these two very opposite kinds of earth. Under such circumstances, the practice has been, in nine cases out of ten, to raise the embankment with the stuff from the cutting, teamed over head without any regard to separation; and the consequence is, a mass composed of a perfectly irregular mixture of the two. Now, such an embankment is always in a most dangerous state during wet weather. The sand admits the penetration of water, which by degrees works its way through the whole mass, till at last it begins to carry the sand out with it, forming hollows and vacuities, which invite the lodgment of more water, with all the well-known consequences of frost and other injurious influences. The question therefore is, how should an embankment be formed from a cutting of this kind, in such a way as to keep the sand and clay in separate positions, so that their mixture may not cause the destruction of the whole bank. Probably, the best mode of effecting this is, to throw the whole of the sand or gravel into marginal banks, the outer slope of which should coincide with the general slope of the bank. The engineer should specify particularly that none of the clay is to be used for these marginal banks, but the whole to be reserved for filling the middle space or body of the bank between them, and for carrying it up above them to the proper height. It is not necessary to lay down any rule here for the dimensions of the marginal banks, because these should depend upon the proportion which the sand or gravel bears to the clay in the cutting. In some cases there may be so little of the former, that the marginal banks will be only three or four feet high, and will form mere borders, depriving the base of the great slope; and in other cases there may be so much that the tops will reach nearly to the top surface of the bank: their slopes will then meet at the bottom, and the clay will occupy the place of a wedge between them. However this may be, as to the proportional quantities of the clayey and sandy parts, the method of separation will invariably hold good, and be found serviceable in practice; because the clay serves as the cap to throw off the water, and prevent it from reaching the gravel or sand, to carry them out and convert them into quicksand.

It is scarcely possible to recommend too highly the formation of these marginal banks, as an excellent preventive of slips. Indeed, wherever a clay embankment has to be made, it is worth while even to go off the line for gravel or chalk, to place in this form at the foot of the slopes. There is a certain celebrated railway in the south of England, notorious for more things than for the careless and headlong haste of its execution, in which several embankments were actually made to a considerable extent with fuller's earth put in wet, and the consequence was, in the words of the accomplished and distinguished Major-General, and Inspector-General of Railways, that it "became perfectly fluid, and subsided from above, and swelled out below in an extraordinary manner." It is quite true, that the manner may be extraordinary enough to the individual who thus describes it, seeing that he probably knows nothing at all about the material of which he here speaks. Those, however, who do know any thing of the nature of fuller's earth will not be at all surprised at the readiness with which it was here converted into mud; nor will the ordinary manner in which water acts upon this earth be at all *extraordinary* to such persons. There is, however, one fact which might well have surprised the Inspector-General, as it no doubt will surprise our readers, and that is the blind and stupid ignorance which characterizes the proceedings of men who could suffer an embankment to be made of such stuff, when ten minutes' observation of the effect of rain upon the material would have convinced them of its unfitness.

No person who has ever in his life been at a fuller's earth pit can have failed to observe the care with which the carts containing it are covered with tarpaulin on the least approach of rain. And on inquiring the reason of this care, he will learn from the workmen, that water entirely spoils the material by reducing it into an impalpable mud of very little more fluidity than water itself. The same fact may be learnt by treating an ounce of the earth with a little water in a saucer. Will it be believed, that the wiseacres who tumbled wet fuller's earth into an embankment, actually committed this monstrous folly within half a mile of the most celebrated pits in the country, where they must have had ample opportunities of understanding its nature, but which they chose entirely to neglect, with a sort of reckless presumption, only to be engendered by the most ignorant and self-sufficient conceit.

Art. X.—PARSONS' IMPROVEMENTS IN STEAM-ENGINES AND BOILERS.

Of these improvements the name is Legion, and they certainly display considerable ingenuity, and make it manifest that Mr. Parsons has found out the direction in which the current of steam improvement must run: yet of the whole century of inventions here propounded, there is scarce one of any practical moment, and very few which have even the merit of novelty. We are willing enough to believe, that Mr. Parsons may have re-invented these plans, without any knowledge of what had been done by his predecessors; and his merit is, therefore, as great, so far as the mere process of invention is concerned, as if they had been absolutely new. But the amount of this merit is not likely to make Mr. Parsons much the richer, seeing that none of the plans in question have come into use—a presumption at least that they cannot be of any great advantage. At the same time, we are very sensible that Mr. Parsons' efforts are all in the right direction: he sees very well what should be done, and also how to do it; but the particular expedients he recommends are not the best that are available. His ingenuity leaves him at no loss for resources, but those resources are rather abundant than excellent, and his narrow information shuts him out from the knowledge that they had been tried and rejected by our grandfathers. It is very plain to us, moreover, that Mr. Parsons knows very little of the requirements of heavy marine steam machinery, or indeed, of heavy machinery of any kind, otherwise, he would never have proposed such contrivances as his improved crank framing and key for disconnecting the crank—plans both of them far too feeble and futile to answer a useful purpose.

Mr. Parsons' first crop of improvements consists of a variety of arrangements for the better application of high pressure steam to marine engines. He makes use of common locomotive boilers, and double cylinder engines on Woolf's principle, and he also condenses the steam by external cold. This is all very well, though we should much prefer the single cylinder engine, to the complexity of Woolf's, which is possessed of no advantages capable of covering its evils. The double cylinder engine accomplishes no saving of steam, and only equalizes the action a little, which in a steam vessel is of no importance. The parts of a Woolf's engine may, indeed, be made slighter than those of an engine on the expansion plan, but the saving in weight thus effected is more than made up by the weight of the extra piston and cylinder, the complicated valves, and the various additional connexions. This part, therefore, of Mr. Parsons' scheme is, in our opinion, bad, and we are very confident that it will not be received with favour. The particular form of engine Mr. Parsons recommends is shown in Plate XXIV, and we extract from his specification the following description of it, for the benefit of those who have sufficient patience to read it through.

"Fig. 1 is a longitudinal section of one of a pair of engines and boilers, but with the boiler represented as out of its proper place, for the purpose of showing its construction and connexions more clearly. Fig. 2 is a plan of the same, with the boiler in its proper place, the position of the same being indicated by the blue lines. A is a boiler adapted to the generation of high-pressure steam, which is similar to those boilers used for locomotive engines on railways. It is provided with a fire-box and smoke-box B and C, connected by tubes, 15, through which the heated air from the fire-box B, passes into the smoke-box C, and up the chimney D. E is a steam-chamber of cylindrical form for connecting the boilers where two or more are used. Safety-valves and gauges are provided as usual, and there is also a soft metal plug inserted in the crown of the fire-box, so that should the water get low at any time the fire would be extinguished before any harm could arise. The steam on passing from the steam-chamber E along the pipe 1, gives, first off through the branch pipe 16, a quantity sufficient to fill the space between the jacket T and the cylinder G, for the purpose of keeping the working cylinder G warm; it then flows onward through a continuation of the pipe 1, and down a pipe 17, to the space V, which encircles the small cylinder U. From this space the steam is taken to work the engine, but before doing so it is made to pass through the valve-box S. The object of passing the steam through this valve-box is to reduce the pressure of the steam when the engine is being worked by hand, and thereby prevent steam of the same pressure as that in the boiler passing into the large cylinder G, which would endanger the working parts of the engine. The steam reduced in pressure passes to the valves *r r* (Fig. 1) as before described. The steam is admitted by these valves alternately to the top and bottom of the small cylinder U, and may be either cut off at any convenient part of the stroke, or allowed to work with its full pressure throughout the stroke. After having acted on the piston *v* it is allowed to pass by the passages 26 and 27 alternately, from the top of the small cylinder U to the bottom of the large cylinder G, its ingress being regulated by the sliding valves 28, 28′, and when it has acted on the top and bottom of the piston H in the large cylinder G, it is allowed to pass from the top of the cylinder G through the valve *a* into the passage C C, and from the bottom of the cylinder G through the valve *a′*, up the passage *b*, into the same passages C C, whence it flows into the condenser Y Y, where it is finally condensed. A sectional elevation of the condenser Y Y is contained in Fig. 1. It is composed of corrugated plates of copper, but may be composed of any other suitable metal; which plates occupy the space between the air-pump and the outside casing, with the exception of spaces which are reserved for the admission of cold water, which is caused by means of a pump or other suitable contrivance to traverse the conduit *f*, (Fig. 1,) and then to circulate among the corrugated plates, whence it passes out through the pipe *d*. The air-pump W, (See Fig. 1,) is double acting, and worked by a small beam *z*, but differs from those in ordinary use, inasmuch as none of the water arising from the condensed steam is allowed to pass through it, being kept exclusively for pumping the air and uncondensed vapour from the condenser through the bottom valves 20 20, and top valves 20′ 20′, and afterwards discharging it through the passage *e*. Instead of a condenser, such as that before described being used, a condenser of the ordinary form may be substituted, and the air-pump be modified to suit it as follows. Let the bucket of the pump be made like an ordinary piston without valves, but let the pump have two valves at the top and two at the bottom, the former for the purpose of drawing off the air and uncondensed vapours, and the latter for the purpose of drawing off the water, by separate and distinct passages. In some cases I use the top side of the plunger of the pump, with the top valves as a cold water pump for the purpose of supplying the condenser with water, when surface-condensers are employed, separate passages being provided for the same, while the bottom side of the plunger and bottom valves are employed as an air-pump, in the manner before described.

Such is act the first; and next come the claims under this first division, which are as follows:—

"First, the surface condensing apparatus of corrugated plates before described. Second, the application, in manner before described, to steam-engines worked with any kind of surface-condensers, of an air-pump, whether single or double acting, to draw off the air and uncondensed vapours, and of another and separate pump to draw off the water; also using the top of the air-pump and top valves as a cold water pump. Third, the employment, in manner before described, in the case of engines worked with common condensers of a double-acting air-pump, by means of which the water arising from the condensed steam, together with the injection water, are pumped out by the bottom valves, and the air and uncondensed vapour are pumped out by the top valves. Fourth, the method before described, of supplying the waste of fresh water, consequent on the employment of surface condensers. Fifth, I claim the application, in manner before described, to marine engines of high-pressure boilers, similar to those used for locomotive engines on railways, in combination with surface condensers. Sixth, I claim the application, in manner before described, to marine purposes, of high-pressure boilers similar to those used for railway locomotive engines in combination with double cylinder expansive engines, of that class in which the steam is passed from a small cylinder into a larger. Seventh, I claim the three-fold combination, in manner aforesaid, of railway locomotive boilers, double cylinder expansive engines of the class aforesaid, and surface condensers. Eighth, the valve apparatus before described, for relieving the pressure of the steam in double cylinder expansive engines of the class aforesaid, when they are being worked by hand. Ninth, the arrangement before described, whereby, in the case of double cylinder expansive engines of the class aforesaid, the steam in the small cylinder may be cut off at any part of the stroke, and the communication between the two cylinders is effected by passages different from those by which the steam is admitted into the smaller one. Tenth, the employment, where high-pressure boilers of the railway locomotive description, are applied to marine purposes, and where there are two or more used, of a common steam-chamber of communication in manner before described. And, eleventh, the arrangement before described, whereby, in the case of double cylinder expansive engines of the class aforesaid, the shaft is placed above the two cylinders, and the beam or beams for transmitting the power of the steam to the crank are also placed above the same cylinders."

Of the whole of these claims there is only one we think tenable, and that is the second. We may add, too, that we think the improvement referred to in the second claim is a very good one: and, to us, that part of it which relates to the use of one pump for drawing off the air and vapours, and another for drawing off the water, is new, though the rest of it is not new. Claim third is old: it was patented long ago by Mr. Atherton, and, we believe, by numerous other persons. Claim 4th, relating to the use of a still for making up the leakage by evaporation, of course is old. The 5th is old, and, even if new, is inadmissible. The 6th and 7th are likewise inadmissible, simply because they involve no invention. Mr. Parsons might as well claim an exclusive right to the use of direct-action engines in connexion with paddle-box boats or disengaging apparatus. The 8th is useless, if the engines are properly made. The 9th unnecessary. The 10th preposterous. The 11th bad enough to render the protection of a patent unnecessary. Putting in such claims as this, when scarcely one of them can be sustained, is an abuse of the privilege of patent, and should be put down. We do not know what influence this display may exercise upon other minds, but to us it strongly suggests that Mr. Parsons' talent is not equal to his cupidity.

We cannot afford to give an account of all Mr. Parsons' improvements, nor would the task repay the trouble. There are eleven heads of improvement altogether, and we have only enumerated the contents of the first, which is by much the least unimportant. There is only one contrivance among the other heads which we think worth notice, and that is a sort of gasometer engine, shown in fig. 3. It is by no means so good as common engines, but exhibits much ingenuity of a fantastic and irregular kind. This engine is, in our eyes, the cleverest of Mr. Parsons' plans, and the most outrageous. L is the cylinder, N the condenser, W the air-pump, D a space between the condenser and cylinder, forming an annular cylinder. The steam is first admitted into D, from thence by the valve K into L, which is the large cylinder, the annular being the small one, and from L into the condenser. The cylinder is raised by the pressure of the steam in L, and brought down by the pressure of the atmosphere, and the pressure of steam in D.

Before leaving Mr. Parsons, we think it right to say how far we can subscribe to his opinions, and applaud his plans. We think with him, that the panacea for the ills under which steam navigation is suffering, is the use of high-pressure steam worked expansively; and that to use high-pressure steam with safety, boilers on the locomotive principle must be employed. But Mr. Parsons and ourselves do not monopolize this knowledge; for there is scarce an engineer between this and John-o'-Groat's who does not rest in the same conviction; and, indeed, the introduction of locomotive boilers and expansive action has already risen to a considerable pitch. We think, too, that the use of some mode of keeping the boilers supplied with fresh water is almost indispensable when the boilers are of the locomotive description; but Mr. Parsons' patent is by no means the first for that particular combination. In short, we think that, by the time Mr. Parsons is stripped of all that does not belong to him, he will have very little worth keeping left—nothing, indeed, that we now remember, except the application of the feed-pump immediately to the condenser, instead of to the hot-well as is the usual practice.

ART. XI.—RANSOME ON AGRICULTURAL IMPLEMENTS.

The Implements of Agriculture. By J. ALLEN RANSOME. London: Ridgway. 1843.

Messrs. RANSOME and Co., of Ipswich, are known every where as the first makers of agricultural implements in this, and we suppose, in any other country, and any communication they may favour the public with on such a subject will carry corresponding authority. Mr. J. Ransome, the author of the work before us, is one of the partners in this far-famed firm, so that we must look upon his work as in some measure exponential of the opinions, and embodying the experience of Messrs. Ransome and Co.,—a circumstance of no little weight, in the estimation of those to whom the author is unknown personally. With these claims upon our attention, we could not do otherwise than give the work a perusal, and we shall here state the nature of our discoveries.

The work is divided into fourteen sections. The first and second sections are devoted to the subject of ploughs, and are among the most interesting and important in the book. The first section begins with an account of the ploughs of the Greeks and Romans, the ploughs at present in use among the Hindoos and Chinese, with a variety of similar barbarities; and from these fundamental types traces down the several progressive improvements to the present perfection of the instrument. Numerous specimens of the most approved modern varieties of the plough are figured, and a compendious statement is given of the principles by which the construction of ploughs ought to be regulated.

The third section treats of harrows and scarifiers, of which a number of the most approved examples are given—the fourth of rollers—the fifth of drills—the sixth of the various kinds of the horse hoe,—and the seventh of rakes. Under this last head, a description is given of the most approved variety of the hay-making machine, a contrivance, of the value and efficacy of which Mr. Ransome speaks in the highest terms. Section eight treats of the numerous varieties of the thrashing machine. Section nine, of the winnowing machine.—Section ten, of chaff-engines, and section eleven, of turnip-cutters, a species of instrument used for slicing turnips, chiefly for the accommodation of sheep.

Section twelve is devoted to the important subject of mills for grinding corn, of which a vast number of varieties are enumerated. Among the more recent varieties of the flour mill, that constructed by Messrs. Sharp and Roberts has certainly the merit of ingenuity whatever its efficacy may be. In this mill an *eccentric* movement is given to the millstones, in addition to the usual rotatory one, by which it is supposed the more effectual trituration of the grain will be accomplished. In the machines for polishing marble this combination of an eccentric with a rotatory movement has long been employed with the happiest effect, the object being to counteract the tendency of a mere rotatory motion to leave scratches on the surface. We have not, however, heard that similarly beneficial results have followed the application of this plan to the millstone.

The thirteenth section of the work speaks of the Dynamometer as applicable to the determination of the draught in ploughing. The common dynamometer is unsuitable, Mr. Ransome says, to this purpose, from the want of some expedient to take account of either distance or time. These materials, however, it occurs to us might be supplied by observation. The fourteenth and last section discusses the applicability of the steam-engine to ploughing, as well as to various other agricultural uses, and gives a popular account of the principles on which the steam-engine operates, so as to convey some notion of the thing to farmers, and others ignorant of scientific subjects. This section also contains a list of all the patents which have been obtained for agricultural improvements during the last two hundred years.

We regret that our limits compel us to make our notice of this interesting work so very meagre. It is a work full of interest to all, and to farmers is of the utmost importance, for we can well conceive that a reference to its pages may stimulate to the adoption of the most approved modes of agriculture, and obviate an expenditure on needless experiments. There is one fault, however, we are disposed to find; we think Mr. Ransome too liberal in his commendations, and while he never fails to extol the merits of a particular contrivance, he is rather addicted to glossing over its defects. While, however, we must state this as a fault, and a fault it certainly is, we cannot but admire the delicacy and kindliness in which it has manifestly originated. The contrivances Mr. Ransome extols are mostly those of rival manufacturers; and Mr. Ransome probably thought, while treading on such difficult ground, he should be careful to say nothing which the most distorted vision could attribute to jealousy, animosity, or envy. This motive, however, could not have been the ruling one, when speaking of plans brought forward by obscure schemers, and whose demerits have already worked their dissolution; nor can we for a moment imagine that Mr. Ransome was insensible to the vices of those contrivances, or that he could not have exposed them if he pleased. The fact appears to be, that Mr. Ransome is one of those benevolent persons who are unwilling to say any thing which can give a moment's pain to any living being, and, although we must blame him as an author, for this peculiarity, we must all the more admire him as a man.

ART. XII.—OUR CLUB. No. VI.

The bow unbent its power will lose,
The mind o'ertask'd its strength refuse;
You loose the bow—its powers renew,
Relax the soul you nerve it too.
So fields by rest, their strength regain,
And golden harvests crown the plain.—CLUB.

SCENE.—*The Club Room.*

Present SIR JONAH *and* MONTGOMERY, *the former reading a manuscript—the latter at work with his pencil upon sundry scraps of paper.*

MONTGOMERY. (*Throwing his pencil down, and himself back in his chair.*) I feel that I am doing violence to my nature: a weariness comes over my spirit, so long poring over these dry mechanical details. I languish for a draught of "Castalie's pure stream,"—for a whirl in the vortices of fancy.

SIR JONAH. A wise and worthy aspiration unknown to sordid hearts. The mind, like the body, requires its times of repose, and he who would use any part of life well, must be content to spend much of it in mere amusement. Besides, we are endowed by nature with many dissimilar capacities—

MONTGOMERY. And we should not be fulfilling the designs of nature, if we did not permit them all to receive their proper development.

SIR JONAH. Precisely so; and it has therefore always been my aim to make the class to which our pages are more particularly addressed to *feel the dignity of their nature:* to recollect that they are not artizans only, but *men;* and that they should not merely teach their hands to work, and their heads to reason, but their hearts to feel.

MONTGOMERY. I recollect the time when I would read nothing which did not bear upon my immediate occupation at the time. I found my mind narrowing by degrees into a mere atom, and but for your interposition I should long ago have dwindled into a paltry automaton, a mere parody upon man.

SIR JONAH. The disease is rife among our artizans even yet: here is a letter from some engineer I presume, stating his hope that we will devote one-half of each number to the subject of marine-boilers, and the other half to that of locomotive engines. Now, that is one of the machine class of minds—a mere *Iron-man*, to whom heaven itself would have no charms if destitute of steam-engines.

MONTGOMERY. I hate steam-engines, yea, and all the useful arts, when I find them turned into instruments of degradation—materializing the mind—quenching the lights of the soul, and polluting the heart's most sacred fountains. I pity the man sincerely, who can only think of the petty details of his own petty art, and narrows capacities which may embrace all creation into the compass of a turning lathe, or steam-boat boiler.

SIR JONAH. It is, of course, important that artificers of every description should make themselves proficients in their respective arts, but what I find fault with is, that they seek nothing beyond that proficiency. Many of them are assiduous enough in adding to their information, but that information is for the most part of a narrow and exclusive character, the effect of which is to overset the proper balance of their minds, and make them self-sufficient, prejudiced, and worldly. They imagine their own occupation to be the most important in creation, and themselves—who shall measure their self-sufficiency?

MONTGOMERY. Many of the Mechanics' Institutions must be excepted from this condemnation.

SIR JONAH. They must. A large number of them are conducted on very enlightened principles, and the curriculum is very comprehensive. Here is one, for example, where the fine arts hold a distinguished position—just established at Newbury; and in several others there are lectures on poetry and other subjects, which are calculated to be productive of the happiest influences.

MONTGOMERY. They will diffuse a taste for the pleasures of the imagination.

SIR JONAH. Yes, and in doing so will wean multitudes from vice and folly. There are a large number of the humbler classes who are incapable of distinguishing between pleasure and dissipation, and cannot enjoy leisure without plunging into guilt. We should therefore seek to extend as widely as possible the sphere of innocent pleasures, so that men may not be driven upon those which are criminal, and it is in the cultivation of the imagination that these pleasures are chiefly to be found.

MONTGOMERY. And in the survey of nature. Oh! let me go forth from the murky city to drink the pure air of the solitary hills—to bask in the virgin sunshine, with not a cloud between me and the bright blue sky which sweeps away into infinitude.

SIR JONAH. To inhale the perfumes of the morning—to listen to the melodies by which creation utters its gratitude.

MONTGOMERY. Secure from all intrusion, except the lights and shadows of my own contending thoughts, and breathing unutterable emotion into the attending ear of nature.

Enter SCALPEL (*silently.*)

SCALPEL. Ear of nature! well that is capital. So then nature consists of a room 10 feet square, and the ear—I suppose, that means the chimney-pot.

MONTGOMERY. Avaunt—profane.

SCALPEL. What has become of the bottle? Its absence may possibly account for this inspiration.

SIR JONAH. We were just entering upon a delightful theme—your interruption jars upon the spirit.

SCALPEL. Oh—in the poetics! Well, I have just recovered from a fit of the same disorder, and I put down a few thoughts to be turned into poetry as soon as I get my Rhyming Dictionary back from the binders.

MONTGOMERY. Worse and worse—fine thoughts, no doubt.

SCALPEL. Yes, they are: I will let you hear them.

MONTGOMERY. After they have been made to clink will be early enough—not now.

SCALPEL. I might lose the paper. (*Reads.*) How beautiful are thy scenes, O Earth! thy softened landscape, and thy rugged mountains—

MONTGOMERY (*aside.*) [Execrable!]—Give it to me, and I'll turn it into doggrel. (*Takes the paper, and reads.*)

1.

How beautiful, O mother Earth! thy varied scenes to me!
Whether the cultured landscape smile with soften'd majesty,
Or, in thy sterner aspect, rocks in wild confusion rise
Abrupt, magnificently grand, their summits in the skies:
Whether thou gleam'st with Winter's sheen, or Spring's glad smile dost wear;
With Summer blossoms clothed, or leaves pale with the dying year.
Though 'neath night's star-inwoven mantle wrapt in sacred gloom,
Or blushing in the morning light, all fragrancy and bloom;
Or basking, with voluptuous looks, in noontide's fervid ray,
Or smiling through thy dewy veil meekly at close of day;
Still, mother Earth! in every mood, in every varied change,
My heart could almost worship thee—so wonderfully strange!

2.
And thou, O Ocean! beautiful, most beautiful thou art,
And ever to my care-worn soul fresh joy dost thou impart.
Whether fierce-wing'd with tempest wrath thou battlest with the sky,
Or lull'st thyself with low sweet moan, faint as an infant's sigh;
In all thy shifting forms I see the wonder-working skill
Of Him who wakes thy wildest rage, or whispers "Peace! be still!"
Thou mighty reservoir! vast cauldron! ever pouring forth
Into the spongy air thy mists to fertilize the earth!
Like the heart's life-blood pouring through each artery and vein,
Returning by unnumber'd tubes back to the font again:—
So sea-fed clouds descend, springs gush, and rivers feed the main.
Ocean! I never gaze on thee but solemn musings fill
My eyes with tears, my heart with an unutterable thrill.
Thou twofold emblem! of eternity thyself; thy waves
Of time—which rising from thee, find within thyself their graves.
Vast as thou art, the Moon's behests thou dost perforce obey;
And, as she bids, dost rise or fall, quiescent to her sway.
Great moral lesson! did we thus to Virtue's rules conform,
Ne'er should we mourn the wreck of peace amid our passions' storm!

SIR JONAH. Is it over? Thank Heaven!

MONTGOMERY. And me. But what could you expect of an improvisatore, and with such materials?

SCALPEL. And with such materials! The draft was a copy from nature—and set down at the time of the emotion.

MONTGOMERY. And is therefore bad.

SCALPEL. Somewhat paradoxical, I guess. Explain.

MONTGOMERY. I thought I had expressed myself clearly enough. I mean that it is the memory of the emotion, rather than the actual perception of it, that is the poet's font of inspiration. A state of violent passion is inimical to its proper depicture. Suppose, if you can, the case of a mother in her first burst of agony at the loss of her only child, or of a lover maddened with the news of his mistress's deceit or death—or suppose, what will serve equally well, some reverse case of as sudden and tumultuous joy—the first startling conviction of reciprocated love—the sudden appearance of some loved object supposed to be long dead—suppose, I say, if you can, persons so circumstanced sitting quietly down to depict their emotions. The incompatibility between the feverish throbbings of either joy or grief, and the calmness requisite for its proper development, is so signal, that no argument is needed. We feel intuitively that the thing is impossible.

SCALPEL. This to me is a strange doctrine indeed. Am I to understand you then as saying, that men cannot affect their fellow-creatures when labouring under powerful emotions, so powerfully as when their feelings are tranquillized? For this, if I understand you right, is the upshot of your remarks—namely, that the lover would be the more likely to ingratiate himself with his mistress the more unimpassioned were his suit; that the voice of grief, if it lost some of its earnestness, would be more piercing in the ear of pity.

SIR JONAH.—Nay, you misinterpret our young friend entirely. His observations, legitimately carried out, lead to no such conclusion as you would draw from them. That a person labouring under any powerful emotion would be able, whilst under the paroxysm, powerfully to affect others, there can be no gainsaying. Nature has given to us a language of tones and gestures, which far more than mere words, makes its way at once to the heart. Strong passion is many-tongued. Anger speaks to us not the less by his gloomy brow, flashing eye, and compressed lips, than by the sternness of his voice. Distress, too, wins her way to our feelings by her supplicatory gestures, by her tone of entreaty, and by her streaming cheeks, or the tearless agony of her eye. In either case the mere words may in nowise be indicative of the passion, and therefore powerless in awakening its correspondent feeling in the breasts of others: the tone, the manner, are often all in all.

SCALPEL. Precisely my view of the matter. I cannot see in what we differ.

SIR JONAH (*waving his hand in a dignified manner.*) It is not my desire to point out differences between us; my object is merely to substantiate Montgomery's views, although I feel that I might as well have left the matter in my young friend's hands. In theatrical representations this truth is fully recognised. If the hero or heroine of the tragic muse should enter into a minute development of his or her state of mind, analyzing it with accurate precision, or should use elaborate similes, how exquisite soever they may be, we feel at once that it is the poet who speaks, and not the character, who is thus made a mere mouthpiece of: we feel, in fine, that the representation is not true to nature. No man, whilst labouring under any violent passion, ever thinks of describing to another what his feelings at the time are: this can only be accomplished after the emotion has, in some degree, subsided. Thus the following passage in Addison's Cato has been severely and justly reprehended. It is the answer of Portius to Lucia, after she has avowed her love for him, swearing, at the same time, that in the then state of their country, she will never marry him:—

> "Fix'd in astonishment, I gaze upon thee,
> Like one just blasted by a stroke from heaven,
> Who pants for breath, and stiffens yet alive
> In dreadful looks, a monument of wrath."

Instances more striking than this one have met my observation. They abound especially in the turgid tragedies of Young: but I have not the book at hand, and my memory is too treacherous in these matters to furnish me with an example. This quotation, however, I think, will be sufficiently explanatory. The lines which, bating their being somewhat inflated, would have been quite proper in the mouth of another person, or even if spoken by Portius himself when treating of the event at some after-period—coming from his lips in the paroxysm of grief are absurd, simply because they are not true to nature.

SCALPEL. Well, I'll contest the matter no further; for I wish to hear a song from Mr. Montgomery. I would rather a thousand to one be listening to poetry, especially when wedded to music, than arguing the why and wherefore of its soul-entrancing power, and assigning reasons why such and such pieces ought to please us, and why we ought not, on any account, to be pleased with others. Taste may have its laws; but if it have, I think that, like the laws which govern the winds, they are pretty well hidden from mortal gaze. But as our ignorance of the coming and going of the winds does not prevent us from feeling their effects, so poetry, though I may know little or nothing of the mode in which it operatss, charms me nevertheless. All attention! [*Knocks upon the table.*]

MONTGOMERY. You are very importunate. Perhaps you would like to prescribe the subject also.

SCALPEL. O, no! any choice which I might have in the matter I beg to resign to Sir Jonah.

SIR JONAH. Since you have so courteously transferred your very equivocal right to me, I will try what weight there is in it. Perhaps you (*addressing* MONTGOMERY) will favour us with that delightful air which I gave to you a few days since?

MONTGOMERY (*sings*)—

1.
The pomp of power, the pride of might,
May dazzle for awhile;
Yet oh! far dearer is the light
Which gilds my fireside smile,
Where happy hearts and sparkling eyes
Make home, my home, a paradise.

2.
When 'mid the gay and courtly throng
The sounds of joy ascend,
And beauty bright, and dance and song,
Their choicest influence lend,
My spirit soars away to thee
From all the lifeless revelry.

3.
As seeks the wearied bird his nest,
No more abroad to roam,
So longs my harass'd soul to rest
Within my quiet home:
Nor pleasure's cup, nor splendour's dome,
Can tempt me from my simple home.

SCALPEL. Bravo—Bravior—Bravissimus! It is the best song that has for many a day proceeded from this room, so long held sacred to science and—cobwebs.

SIR JONAH (*in a mock-heroic tone.*) I hereby decree that this meeting do now adjourn; and it accordingly stands adjourned to some day in the coming month, like Parliament, to be convened again and again only to be again dismissed, or then and there to meet for the urgent dispatch of business, as my sovereign will and pleasure may be. Of the time and place of said meeting timely notice shall be given.

MONTGOMERY. Thus ends meeting No. 6 of "Our Club."

SCALPEL. Ay: and, what is really wonderful, without the aid of those two boon companions Gray and Glenlivit.

(*Exeunt omnes.*)

ART. XIII.—CLYDE AND THAMES ENGINEERS.

Marine Engines of the Royal Navy: a Letter to the Lords Commissioners of the Admiralty. By ALEXANDER GORDON. London. 1843.

THE purpose of this letter is to show that the Clyde engineers have not hitherto had fair play at the Government head-quarters, and that favours have been dealt out to the engineers of the Thames, of which they are altogether undeserving. Not only do the London engineers get a higher price for their engines on the presumption of superiority, but they monopolize all the orders; and this while, as Mr. Gordon assures us, the Thames engines are neither so economical nor so efficient as those of the Clyde manufacture. This certainly is very cruel treatment, if such things are shown to be. Let us examine the process by which Mr. Gordon has found them out.

Mr. Gordon, we should first observe, is the agent for Mr. Robert Napier, of Glasgow; and although his testimony is none the less credible on that account, when backed with sufficing reasons, yet it behoves us to receive it with greater caution than if he were an idle and unconcerned spectator. Captain Gore moved, it would appear, in the House of Commons, for certain papers connected with the performance of steam machinery, having first availed himself of Mr. Gordon's aid in making out the list. The returns moved for on this occasion are as follows:—

" A Return of the original Cost of the Engines of the following Steam Vessels, specifying any extra Charge beyond Contract Price, and if such Vessels were fitted with an Indicator; of Repairs, and the Cost of such Repairs, and the Number of Days and Hours any of said Vessels were incapable of performing their Work, in consequence of such Repairs; and of the Names of the Makers of each of the Engines of said Vessels.

Names of Vessels.	Original Cost of Engines.	Extra Charge beyond Contract Price.	Indicator.	REPAIRS.			Cost of Repairs.			Number of Days and Hours the Vessels were incapable of performing their Work in consequence of such Repairs.	Names of the Makers of the Engines.
				Nature.	Period over which they extend.						
					From	To					
	£.	£.					£.	s.	d.		
Alecto . .	10,700	297	not fitted	... to engines, boilers, and paddle-wheels.	13 Jan. 1840	31 Mar. 1843	1158	4	4¾	393	Messrs. Seaward and Capel.
Devastation .	18,650	681	ditto	ditto	Dec. 1841	ditto	249	10	8¼	92	Messrs. Maudslay, Son, and Field.
Geyser . .	13,933	440	ditto	ditto	July 1842	ditto	89	7	3½	50	Messrs. Seaward and Capel.
Cyclops . .	22,103	906	ditto	ditto	Oct. 1840	ditto	800	7	10	164	ditto.
Prometheus .	10,700	315	ditto	ditto	March 1840	ditto	1012	1	5½	353	ditto.
Polyphemus.	10,700	214	ditto	ditto	June 1841	ditto	240	7	11¼	162	ditto.
Vesuvius* .	13,480	400	ditto	ditto	Oct. 1840	ditto	37	19	0¼	38	Mr. Robert Napier.
Stromboli† .	13,480	nil.	ditto	ditto	Sept. 1840	ditto	68	6	3¼	51	ditto.

" *Admiralty*,
" *26th May*, 1843.

" Wm. Edward Parry,
" Comptroller of Steam Machinery."

" A Return of the Names of Marine Engine-Makers with whom the Admiralty have made Contracts for Engines, from the Year 1839 to 1843 inclusive; with the Amount of Horse Power ordered from each of such Engine-Makers in each Year.

Name of Engine-Makers.	Amount of Horse Power in the Years				
	1839.	1840.	1841.	1842.	1843.
Mr. John Laird	265	...	...	...	—
Messrs. Maudslay, Son, and Field .	200	400	420	2230	—
Messrs. Seaward and Capel . .	800	1400	...	1035	—
Messrs. Miller and Ravenhill . .	...	...	286	430	—
Messrs. Fawcett and Co. . .	300	...	...	350	—
Messrs. Fairbairn and Co. . .	...	300	20	470	—
Mr. Robert Napier	...	....	300	...	—
Messrs. Boulton and Watt . .	...	...	300	...	—
Messrs. G. and J. Rennie . .	...	...	...	450	—
Messrs. Scott and Sinclair . .	...	...	280	...	—
Mr. Robinson	...	...	...	220	—
Messrs. Acraman and Morgan . .	...	...	20	...	—
Messrs. Penn and Son . . .	...	...	...	260	—

" *Admiralty*,
" *26th May*, 1843.

" Wm. Edward Parry,
" Comptroller of Steam Machinery."

From these returns it would appear that the time and money spent on the repairs of Mr. Robert Napier's engines, during a given period, were less than those spent on the engines of any other maker; and Mr. Gordon therefore infers that Mr. Napier's engines were the best of the lot. But Mr. Napier has had the least number of orders, therefore has Mr. Napier been treated with manifest injustice.—Q. E. D.

It may be barbarous to demolish so ingenious a theorem, yet we must be permitted to hint that Mr. Gordon's logic is more specious than substantial, as we think will be made manifest by the following exceptions:—There are periodical times at which steam vessels require heavy repairs; and if this conjuncture be seized upon in one vessel, and a different epoch in another, it is easy to understand how of two vessels of equal goodness one may appear excessively extravagant, and the other excessively economical. We do not say that any such false comparison has been employed in this case, and, indeed, we fully believe that it has not; but we mention the circumstance to show that any comparison of this kind may be exceedingly illusory, unless extending over a respectable number of years, and taking cognizance of a variety of circumstances.

Another thing we do not exactly understand is, why it is these particular vessels have been selected. They may, for aught the table tells us, be the best vessels of Mr. Napier which are chosen, and the worst vessels of every body else; or those vessels of which the expense of repairs run so high, may have had their boilers burnt through negligence, or have met with some analogous disaster. The comparison, to be a just one, should have comprised all the vessels of all the makers; and we should also have some assurance that the engines in every case have been equally well taken care of. Of two equally good engines, one may be much more expensive in repairs than the other, in consequence of having a bad engineer.

But taking it for granted that in this case all the circumstances were equal, the conclusion Mr. Gordon draws by no means follows from his premises.

All the engines in the table, with the exception of Mr. Napier's, are we believe of the direct action kind, and it is certainly just as conceivable and just as likely that the small cost of repairs of Mr. Napier's engine may not be the effect of the superiority of his workmanship, but of the superiority of the common to the direct action plan. The Alecto indeed may be an exception to this statement, for we are not sure but what she is on the side lever construction; but then we understand she is fitted with Hall's condensers, a peculiarity which renders her incomparable with vessels not so fitted. When Mr. Robert Napier shall have applied direct action engines to steam vessels, we shall then have an opportunity of judging of the merits of his work, or this opportunity might even now be afforded us had engines of a similar kind been compared together; but we hold it vicious in principle to compare the direct action engines of one person with the side lever engines of another, as any difference in the results may be due either to the diverse qualities of the plan or the varying quality of the work.

There is one element, however, more important than all the others, which has been omitted in this return, and of which the London engineers might reasonably complain—we mean the consumption of fuel. It will signify little whether a Clyde engine costs 500*l.* less per annum in repairs, if it costs 5000*l.* more in fuel. We do not of course mean to say that any such ratio as this obtains, but we do say that Thames built steamers are for the most part more economical in coal than Clyde built steamers: probably for the same reason that the Cornish are the most economical engines in the world,—because coals are dear. We are enabled, however, to state that some of the Liverpool vessels are more economical in coal than those of either the Thames or Clyde. The vessels, of which the engines were made by Messrs. Bury and Co., for the West India Mail Company, have been all along known to be the fastest of the whole flotilla; and that now left, for one of them was lost, consumes less coals than any other of those vessels, and less than any sea-going steamer with which we are acquainted.

We cannot afford to follow Mr. Gordon further, nor is our further attendance necessary; for we think we have already shown that Mr. Gordon has failed altogether to show the great superiority of the Clyde over the London engines, which his statistics were designed to establish. Of the direct action engines of Messrs. Maudslay, and Messrs. Seaward, we have never thought much, and we think it unfair to those houses to have such productions taken as the measure of their capacity. The side lever variety of engine has the benefit of the combined improvements of the most eminent engineers for the last thirty years. The plan of direct action enjoys none of these advantages, but is yet an infant scheme; and the mere result is not by any means a fair criterion of capacity, when one engineer is thrown altogether upon untested expedients, and the other is granted the use of the ingenuity accumulated by a multitude of the ablest minds in this and other countries. Our own opinion is, that the Clyde engines are not in the aggregate superior to those of the Thames, and this opinion we do not conceive we should have much difficulty in justifying by a critical examination of each variety of construction. Indeed we question whether we might not without any great trouble to ourselves go a step further, and show that in the more essential points the Thames engines are the best. We have no desire, however, to enter upon ground so invidious, nor to add to the pride with which the Thames engineers are even now ready to burst. But if we find our Clyde friends intent upon glorifying themselves by the aid of disingenuous pamphlets, we shall be compelled to interpose, and we really think they will act wisely not to provoke our animadversion.

Art. XIV.—THE SOUL OF ARCHITECTURE.

We have never met with any very intelligible exposition of the circumstances which determine the character of architectural works. We have an abundance of disquisitions, it is true, explanatory of the reasons why this cathedral is better than that, or wherein they both fall short of certain classical perfections; but we have not met with any attempt to show by what process particular architectural combinations become capable of affecting the heart with emotions of awe or delight, or what principle of design must be adopted in order that any desired emotion may certainly be called up. On this important topic we now purpose to offer a few observations, not with the intent of developing a subject of such extent and difficulty, but rather as an indication of the process by which its better development may be accomplished.

Of designing Buildings.—The first consideration in the design of any building is the end it is intended to fulfil, and, consequently, the kind of emotion it is desirable the architecture should call up. That species of architecture is manifestly unsuitable for a gaol which would be appropriate for a theatre; and it is very important that the style of architecture employed should be in keeping with the intended uses of the edifice. There are four chief varieties of architecture which now occur to us as representative of the chief varieties of emotion demanded by the buildings ordinarily required, and the architect should select that kind which most nearly expresses the particular feeling he is desirous to excite. This feeling should be firmly fixed in his own mind before he attempts to form his design, and, once fixed, it must be kept prominent and inviolate. There must be no wavering as to the emotion which is to be the distinguishing one; and, above all, there must be no attempt to combine emotions inconsistent in themselves. *The great secret of success in design lies in the use of such instruments only as conspire to produce a common effect, and never counteract one another by a fruitless antagonism.*

The four varieties of architecture to which we have adverted are, the sublime, the beautiful, the airy, and the severe. These are the true architectural orders,—being founded not on caprice or accident, but on the nature of things. The first variety is that which is best adapted for churches; the second for palaces; the third for theatres; and the fourth for gaols. There are, of course, an infinite number of other uses to which each variety may be applied; and for some purposes one style may be suffered to blend into another: but these variations must rest with the taste of individual architects, our present purpose being restricted to the elucidation of the mode by which certain definite emotions may be most effectually awakened.

Sublimity in Architecture is to be attained by greatness of size and greatness of manner. No building aspiring to the character of sublimity can be successful unless it be *large of its kind*; and in its details all petty graces should be rejected, and every part constructed with the utmost simplicity and breadth. It is not *absolute* size, be it observed, that is demanded, but size which is great relatively with other things of a similar nature with which we are familiar. Every thing is more or less sublime which is gigantic of its kind. The arch of the Birmingham railway, for example, is felt to be a sublime construction, though smaller than the houses on each side of it; and a colossus will be sublime by virtue of its mere dimensions, though only one-tenth of the height of a very insignificant mountain. Conversely we might show a very large structure will fail to awaken any emotions of sublimity if relatively small in comparison with other objects of a similar configuration. The pyramids of Egypt, for instance, fail at first to awake any sublime emotion, because they are, in effect, only very small mountains. When we come to the reflection, indeed, that they are works of art, and have been reared with incredible labour, the impression first produced may undergo some modification. But all this is a process of reason which many will not take the trouble of going through, and the effect of which, in any case, is weak in comparison with that due to an overpowering sense of immensity. Had the pyramids been formed into the shape of any animated being, their effect upon the spectator must have been instant and overwhelming, and no exercise of the judgment would have been requisite to convince him of their stupendous magnitude.

From these considerations our readers will have no difficulty in discovering wherefore it is that we recommend gigantic images of living creatures as the elements of an architecture which aspires to the rank of sublimity. We go, indeed, a step further, and suggest that the images should be human beings, so that we may avail ourselves of the majesty of the human countenance as an aid to the final effect. Every one knows that sculpture may be made to express a moral dignity and elevation as well as a perfection of strength and symmetry by which emotions nearly akin to sublimity may be called up; and the judicious employment of these instruments cannot fail to contribute to the sublimity of any architectural structure.

We have purposely excluded from these observations all allusion to the existing styles of architecture, nor can we now afford to say much respecting them. We may observe, however, that all the orders appear susceptible of sublimity, if employed on a large enough scale, but in some of the combinations which have been adopted, the sublimity, however large the scale, does not immediately reveal itself. In St. Peter's, for example, the spectator is not at once smitten with awe, by the immensity of the structure, and the same would be the case with St. Paul's, but for the houses with which it is surrounded. The cause of this to us is very obvious; it is due to the pyramidal outline of the edifice, which takes off from the effect of the magnitude on much the same principle as in the case of the pyramid itself. St. Paul's being surrounded with houses furnishes a standard of comparison, by which the true magnitude is made to appear, but St. Peter's being unprovided with any such exponent, leaves the spectator without any means of at once comprehending its dimensions. In buildings, which are either very high in proportion to their breadth, or very broad in proportion to their height, this illusion does not obtain, for there one dimension furnishes a standard of measurement for the other. Neither will it hold in constructions, in which gigantic human figures are introduced, for there the spectator has a standard of measurement in his own insignificant stature.

Beauty in Architecture is to be realized by the congruous combination of beautiful elements. Here richness should take the place of simplicity, and if human figures be introduced, they should be of very moderate dimensions, and their countenances should harmonize with the desired emotion. In this species of architecture, colours and gilding should be employed, and no ornament should be rejected which is capable of adding to the general splendour. There should, nevertheless, be a certain air of solidity preserved, without which it is impossible to preserve majesty of expression. Forms of decoration selected from the vegetable kingdom, combined with the most beautiful forms of the animal kingdom, are the appropriate elements of this architecture, and every object should be rejected which naturally awakens associations of terror, hatred, or disgust.

Elegance in Architecture is to be attained by expedients similar to those enumerated above, but there should be less solidity and magnificence, and more airiness, plainness, and ease. The elements of decoration, adopted should be almost exclusively taken from the vegetable kingdom, and they should be such as are graceful, and flowing, and unencumbered with exuberant vegetation. This variety of architecture appears to be that which is most appropriate for cast iron. For churches it is wholly unsuitable, and has even too much gaiety and frivolity to be tolerable for private residences. But for places of public amusement, for summer-houses, green-houses, and other similar uses it seems to be well adapted; and will, we are confident, before long come into extended use.

Of the last variety of architecture we have mentioned, and which we distinguish as the *severe* kind, it is not necessary that we should say much. It aspires neither to sublimity, beauty, nor grace, but merely seeks to convey the sense of sternness and solidity. Of this species of architecture, a number of excellent examples are already to be met with in our various gaols, as well indeed as in some other edifices where a different style would have been more appropriate.

We know very well, we shall have numerous objectors to all that we have here said, and while some will say that our doctrines are heretical, others will allege that they are too vague to be of much practical utility. In the latter objection there is some force; but it is impossible to be both general and specific at the same time, and within the compass to which we are restricted. At present, our purpose is confined to the communication of sound general views, and such as are founded not on precedent, but on nature.

ART. XV.—HOW TO MAKE STEAM VESSELS PAY.

GET a captain who is not a navy man, or at least who is not one of that very common description of navy men who are always above their duties; and let him be one who will not intermeddle with the engineer. A captain of some smack or collier is best, who will look upon every shilling spent on his vessel with a very grudging complexion, and who when under weigh will never be content unless he has all the sail on he can carry. Having obtained such a captain, let him appoint his own mates and crew, so that he may have perfect confidence in the persons he is commanding, and perfect authority over them.

Get an engineer who has been brought up in Cornwall, or some other place where there is a great dearth of coals, or at least who has an adequate conception of the value of that commodity. Let him select his own mate and firemen, and let a clear account be kept of the expense of engine stores, coals, and repairs, so that the same may easily be compared with the expenditure of other vessels.

Make the situation of captain, engineer, and indeed of every one on board worth the tenure by good pay and good treatment, so that changes may be infrequent and every servant may be tempted to feel some interest for his employer. On this, however, very little reliance is to be placed, and the great antidote to misconduct must lie in the certainty of detection and the certainty of punishment. Let an inventory be taken of every article of furniture in the ship, of which there should be three allotments—one for the mate, one for the steward, and one for the engineer. For all ropes, sails, awnings, &c., the mate should be held responsible, including the things in the care of the carpenter and boatswain, which he should oversee. For the whole of the cabin furniture the steward should be held responsible; and the engine-room furniture, such as spanners, oil-cans, duplicate machinery, lamps, and all the other et cetera, should be accounted for by the engineer. The catalogues should be called over and the possession of the articles formally transferred on any change of mate, steward, or engineer.

A vessel, to be a profitable one, should be of a good construction, and of a size well adapted to her particular trade. The great fault of the present day is making vessels too large—larger than the trade imperatively demands, and consequently more expensive than necessary. The construction of the machinery, however, is perhaps the most important point. It should be as light as possible, consist of few parts, and above all should involve a moderate consumption of fuel. Side lever engines are too large and too heavy, and should be altogether exploded for steam vessels. Most of the direct action engines, however, are very bad: we shall take occasion at some future time to point out the varieties to which a preference should be given.

Steam boat boilers should be of the locomotive description, so as to carry out the principle as far as possible of working high pressure steam expansively. It is not indispensable to the operation of the locomotive boiler that fresh water should alone be used, nevertheless it is very desirable, and some species of condenser should be adopted which is capable of attaining that end. Symington's plan of *cooling* the water and then returning it for injection is in our eyes the best. It is much less expensive than any other, and is little liable to leakage, there being no vacuum in the pipes.

The engines should be wrought expansively to a large extent *at all times*, but in fair winds more expansively than in head winds. Some steam boat captains there are who will never set a stitch of sail, however fair the wind may be. This should be seen to. Every yard of sail set saves a quantity of coal, for it enables the engineer to work so much the more expansively without diminishing the vessel's speed. There is no more important element of economy in steam vessels than this of expansion. It will enable one vessel to earn a fortune where another would lose one.

The selection of coal is another point of great importance, but one upon which we can lay down no precise rule, for the coal which answers best for one boiler will not always answer best for another. As a general rule, however, the best variety of Welch coal, such as the Graigola, is the most economical; and this rule will especially hold in the locomotive variety of boiler, where bituminous coal is inadmissible. Much too depends on the length and inclination of the fire-bars. The common practice is to make the fire-bars too long. We have frequently known some feet in length to be taken off them with the happiest effect, increasing the generation of steam and diminishing the consumption of fuel.

A good system of accounts is so essential to the well-being of every kind of commercial business, that it would be superfluous to insist upon its advantages in this particular case. The coal account, however, is rarely kept with that precision which is necessary to show the exact expenditure, and to detect defective supply or wasteful expenditure. The same may be said of the oil and tallow account: these accounts must be particularly looked to.

Insurance is not a thing to be recommended where there are a number of vessels, *and where they are well managed.* There should be no steamer, in our opinion, without the water-tight bulk-heads: their general employment would greatly diminish sea risk; and they should in every case be so made, that there is no plug or door which *can* be left out or open. The bilge pump pipes should pierce the bulk-heads with flanges on each side, so as to make the place they go through water-tight.

Such are a few of the chief means we should recommend for limiting expenditure. Of the expedients for increasing income, it will not be expected that we can say so much, for they must vary considerably with different trades, and also with the circumstance of whether or not there is an opposition. If there is an opposition, it is desirable for both parties that it should be carried on in a friendly spirit, and an arrangement should be come to, that neither party shall resort to the folly of cutting down the fares. This being settled, plans must be adopted to secure the good feeling of the shippers, and every expedient of agitation and advertisement must be pushed to the uttermost. These expedients are too much neglected by some steam companies: they repose much too securely on their dignity, and the consequence is that they fall into the back ground, and fail to earn the reputation due to their actual merits. Any such fault as this must be fatal if there be an active opposition; and even where there is a monopoly will be injurious, especially if the steam company be a joint stock one. People will not take shares in a company of which they never hear.

In addition to all this, the comfort of passengers when on board must of course be particularly looked to; and in the case of an opposition, it is a politic extravagance to fit up the cabins with much magnificence, for there is nothing more certain, than that nine-tenths of the persons usually travelling by steam-vessels judge of the ship by the cabins. If the cabins are magnificent, the ship is supposed to be magnificent; and although we may laugh at the folly, we must not shut our eyes to the fact. In a similar case, a difference of five or ten minutes in the speed on the voyage will sometimes give a vessel the preponderance of passengers, and under such circumstances a little extra speed should be given by a little less expansion, and a larger consumption of coals. The question is one simply of profit and loss, and should be resolved accordingly.

If all these things be properly carried out, and the vessel still does not pay, she will not pay at all, and the sooner she is taken from the station the better. The great secret of success in steam navigation is to have no magnificent ideas. People almost invariably begin with them, but after awhile they find they will not do, and are obliged to give them up. Nor should any captain be employed who is infected with such ideas, for he is almost sure to be inefficient, and to run his owners into great unnecessary expense. Then, again, there are some captains and engineers who are great improvers, and are never happy unless they be altering something or other about the vessel. This should on no account be permitted: once the vessel is made there should be no alteration, whether the particular thing wanted to be altered is a good or bad one, provided only that it can be made to work. It is no reason for an alteration that a certain thing is inconvenient, or troublesome, or clumsy: those reasons might have been very good *while the thing was being made*, but once made, it should stand, so long as it remains capable of fulfilling its intended purpose. Such are the ingredients of our recipe for making steam-vessels pay.

ART. XVI.—GRAY'S FIRST EPISTLE TO THE CLUB.

Braemar, month of August.

DEAR FRIENDS,—Forasmuch as it is not to be expeckit that the maggyzin can go on properly without me, I have, after much cogitation within myself, thought it only a proper thing to send you this epistle to help you over this month, so that the world may not suffer because I am absent in the flesh. I have wrote several articles since here I've been, for we have had a good sprinkling of wet days; and my landlady said that I had catched so many other English ways that I would be such to catch cold if I got drookit. But then, on the fine days, I have been busy enough among the grouse and black cock, so that, what with dry days and what with wet, I have articles both for the club and maggyzin. N.B. Mind to have the bottlejack mended, as the spring was broke when we put the works into the small steam-boat.

I came down in the "City of Aberdeen" steam-boat; and a fine boat she is, only her sponsons are too wide. The captain and I got uncommon thick; for you can have no idea of his civility when he heard I belonged to THE ARTIZAN. Those Aberdonians, you must know, are great people for science and religion. Those of them who can find time to read nothing else, will read their Bibles and their ARTIZANS; and I believe they begin to look upon me as a kind of prophet; for, as soon as they knew I was on board, there was a meeting of the town council to do me honour; and many animals, forbye hens, were sacrificed on the joyful occasion. But it would take too much time to tell you all about the grand reception I met with; which must, moreover, be known to all the world and yourselves by this time, through the public prints.

On my way down I put down upon paper a few observations upon steam engines, which I obteened from the engineer of the "City," an old shopmate of mine, and a particular sensible lad. The engines of the "City" were made by Scott and Sinclair. The pistons are composed of three rings, each consisting of six or seven segments, and pushed out by V blocks, acted on by a steel hoop, which serves as a spring to each block, by being forced down between the blocks and the body of the piston. I never liked this plan of piston very much; for it is not only difficult to make, but it is impossible to grind it afresh, if it gets into bad order. Howsoever, the "City's" piston is not in bad order yet, although it has been at work several years, and is still quite tight.

As you are going to have something about pistons this month, I will here set down something about pistons in general, so as to direct your footsteps. The kind of piston which I like best is the piston which has a single ring, with a tongue-piece and plate at the back, and the cut ends bevelled, to prevent the open space from making a ridge in the cylinder. This, you will observe, is Maudslay's kind of piston, but Maudslay spoils his by not putting sufficient springs at the back. A ring without springs will not do for a large cylinder; nor will it do if the springs are not made very strong. I never yet saw springs too strong, and I have often seen them not strong enough. Maudslay's folk first made the West India mail-boat pistons without springs, but they would not do; and they afterwards put in springs, to keep the packing out. But the springs they put in were poor weak things, and they are now packing the back of the rings with hemp. But hemp is a continual plague, and is not needed if the springs are strong enough. Millar's pistons are very like Maudslay's; and fine pistons they are, or rather would be, if they had only fair play, with good springs; but without good springs, aye, uncommon good springs, neither Maudslay's nor Miller's pistons can, in large engines, continue to give satisfaction. As to the pistons of the "Great Liverpool," which I understand you intend to set forth, it is a clumsy plan enough, in all conscience. Spiral springs! The thing is ridiculous. And then you can do nothing with it when it begins to wear. You cannot even grind down the junk ring without clipping off the lugs which project into the body of the piston. As regards the way of fixing the rod into the piston, I like a gib and cutter the best. A nut on the piston rod gets so sorely roosted after a while that it is all but impossible to get it off: that plan is, forbye, more expensive.

The engineer of the "City" tells me that he was very much bothered at one time with the breaking of crank pins, the fact being that the pins had not been very well fitted at first, and the pin eyes consequently worked oval, and the pins broke off at the cutter holes which held them in. This evil he remedied by making the holes very fair, and fitting in new pins very particularly. He was also troubled with the parts of the pins, situate in the loose eyes, cutting away very quick, and screeching whiles most dreadful, in spite of all the ile he could pour in. He tried all kinds of steel cods and other such things without success; and did not cure the evil until he fitted an entire brass bush into the loose eye, and made the pin bear *all the way across.* I told him, when he mentioned this plan to me, that his pin would be very apt to break whenever the outer end of the shaft fell; but, to guard against this, he has made the section of this part of the pin an oval, so that it bears before and behind, and not at top or bottom; by which means any angulation of the eye, occasioned by the fall of the out end of the shaft, may take place without distressing the pin.

He told me of a variety of other plans that he had introduced with good effect; but there is only one other that I shall now mention, and that is the introduction of a brass into the eccentric gab. You are no doubt aware, that the eccentric gab, as usually made, is a steeled notch, and the pin which fits into it is steeled also. These two surfaces, after some wear, cut into one another, making it both very difficult to throw the eccentric out of gear, and deranging, to a certain extent, the action of the valve. When this had taken place in the "City," the engineer got the gab chipped out, and the pin newly turned up, and fitted a brass bush, made of the ordinary bush metal, into the notch, with lugs of course on each side to hold it in, which lugs were sunk into the eccentric rod, so that there might be no projection on which the pin might catch. This plan has now been in action for a long time, and scarce any wear has taken place, whereas on the common mode of construction, the wear by this time would have been very considerable.

The performance of the "City" has been very carefully ascertained, and the engineer had it all down in his log book. But it was too much trouble for me to copy out at the time, so I requested Airchie to write it out at his leisure, and send it after me, which he did, along with a letter, which you will find herein.

Ship's Course.	Time on Passage.		Number of Strokes.	Draught of Water. Fore.			Draught of Water. Aft.	Wind and Weather.	Consumption of Coal per Hour.	Number of Miles out edge of Float has travelled.	Loss Per Cent.
	hours.	min.		Ft.	In.	Ft.	In.		Cwts.		
South......	24	45	16,350	14	0 ×	15	3	N.N.W. fresh.	27	243.20	9.058
North	23	15	22,315	11	6 ×	13	3	W.N.W. very strong, heavy sea.	35	331.93	48.834
South......	25	10	16,557	13	10 ×	15	0	W. by N. fresh.	27	246.28	10.439
North	27	10	22,538	11	6 ×	13	9	N.N.E. very strong, heavy beam sea.	30½	345.06	54.735
South*.....	26	50	16,338	14	0 ×	15	0	S.S.E. light.	26	243.02	8.977
North*.....	19	40	22,827	11	9 ×	13	6	S.W. light, smooth.	36	339.53	52.255
South......	23	40	17,270	13	2 ×	14	8	W.S.W. fresh.	28	256.88	15.192
North	20	0	18,530	12	0 ×	13	2	W. light.	32½	275.63	23.600
South......	23	20	17,975	13	3 ×	15	0	N.E. fresh.	28½	252.50	8.744
North	20	5	20,740	11	0 ×	14	0	S.E. by S. light.	34	308.50	38.430
South......	25	35	17,800	13	4 ×	15	0	W. by S. light.	27½	264.77	18.730
North	22	20	21,000	11	3 ×	12	9	N. fresh.	32½	312.37	40.076

Abstract of Six Passages from Aberdeen to Hamboro' Head, and Six Passages from Hamboro' Head to Aberdeen.

	H.	M.	
Time, going from Aberdeen to Hamboro' Head . . .	149	20	burning 200 tons of coal.
Time, going from Hamboro' Head to Aberdeen . . .	132	30	burning 220 tons of coal.
	16	50	

Gaining, in time, 16 hours 50 minutes, at an expense of 20 tons of coal.

"*City of Aberdeen Steamer*, 20*th August*, 1843.

"Dear Alick,

"I have sent you a table of 12 passages, of 223 English miles each, performed by the *City of Aberdeen* from January to May. My attention was first directed to this subject by seeing a number of plans for reeving floats, none of which, in my opinion, would stand the action of a sea-going vessel. The plans I allude to are in the *Practical Mechanic, and Engineers' Magazine*. But allowing them to be capable of standing the action of the sea, I do not think there is so great an advantage by them as is generally thought. You will see by this table, that when the engines are going at their calculated speed (19 strokes,) they are loosing 52 P. C. of the travel of the wheel; whereas, when they are going at 10 strokes, they only loose about 9 per cent., in the one case burning 36 cwt. of coal per hour, and in the other 26 cwt. per hour; of course there is a differance of 7 hours in time; but the up-going passage has a head wind to contend with, and the down-coming nearly a fair one: I allude to the two passages marked * thus. I have likeways sent you a scetch of the wheel; the outside of the float is 25 feet dia.; the float is 2 feet 5 in. broad, by 8 feet 9 in. long; so you can see what float surface is immersed at the differant draughts. I think if you would lay this before the first meeting of '*Our Club*,' it might bring out something, or if you could get a simelar table from a vessal with a screw propeller, it would be interesting. I hope this will find you well, as it leaves me at present."

This is all just according to what I have found myself; for I have at sundry times and in divers manners tried to reduce the resistance on the wheel, so as to let the engine get away quicker. But in a heavy vessel it will not do, for you will then be wasting much of the engine-power, in throwing the water back from the wheel. The fact is, there must always be a certain ratio between the speed of the wheel and power and resistance of the ship, and any variation from that causes a loss of power. I am going to-morrow to Lochnagar, along with some of the folk, frae Invercauld, that have appointed to meet me. We are to start braw and early, and it is now gayen late, so no more at present from

Yours very considerably,

Alexander Gray.

Art. XVII.—THE RAILWAY MONOPOLY.

Mr. C. W. Williams, we find, has presented a petition to parliament, enumerating some of the iniquities of the present railway system, and praying that the government may take the management of the whole railways of the country into its own hands. We are very glad to see this step taken, and we trust it will be followed up by petitions from every place of consideration throughout the country. A petition from Liverpool would, we think, be productive of a powerful effect, and we should be very glad to see one got up. It only requires some one to take the first step, and we know of no person better qualified than Mr. Williams for this purpose.

Mr. Williams asserts, and we believe the allegation to be true, that the high charges on the railway between London and Liverpool, has almost entirely shut out Ireland from any participation in the benefits of the railway system. These charges, too, are made to press chiefly upon the less opulent classes of society, and not only are the charges for their transport disproportionably high, but the trains intended for their conveyance are purposely made as inconvenient as possible, and started at times at which no one who can possibly help it will travel. These iniquities cry aloud for redress, and redressed they must be; for the public endurance is assuredly drawing to a close, and the railways will *not* be able to withstand the storm of indignation which presently must burst upon them. Their monopoly might have been perpetuated had they used it wisely, but the scandalous courses into which they have been betrayed by the desire to add to their dividends—their cruel treatment of the poorer classes of society in wringing from them their hard won earnings, after having first extinguished all pre-existing conveyances, have so inflamed the public mind against them, that they must expect but little sympathy whatever be their fate. In the steam vessels with which Mr. Williams is connected, the poor man has the same conveyance as the rich—less splendid it is true, but as safe and comfortable; but in these railways the poor are purposely put into dangerous places, and are thrown upon well nigh impracticably inconvenient hours to heighten the privations of the poor man's fate. Nor is it to the very poorest class of society that this cruelty is restricted. It extends even to the middle classes of society, and throughout the whole railways of the kingdom the most scandalous disregard is shown of every class of the community, except for that very small section who have abundance of money to squander. In Birmingham, for example, an inn has been erected within the limits of the station by the railway directors for the accommodation of the railway passengers, and we should of course expect that its purpose would be to accommodate the ordinary run of persons travelling in this country—an inn, in short, such as a mail coach would stop at for the accommodation of the persons it conveys. Yet what are the charges of this specially erected inn? Four shillings a night for a bed, and other things in the like proportion. Can any further proof be wanting that those only are considered by these railway rulers who have money to squander? What should we say of the proprietors of a coach who thus served its passengers? If, indeed, we think fit to drive to such an hotel as Mivart's or the Clarendon, we cannot complain of having to pay a price corresponding to the grandeur and fashion of the place. But for coach, or railway, or steam boat hotels, to set up similar charges—hotels professedly reared for the accommodation of the public at large, is nothing less than a piece of scandalous extortion. People enter them unconsciously; for the price of accommodation of such places throughout the kingdom is so nearly alike, that no one dreams of extortion. And once the expense is incurred, there is no alternative but to grumble and pay. In the case of mail coach accommodation such evils would cure themselves very speedily, for there, if the public is dissatisfied, another coach can be put on; but in the case of railways there is no such resource, and the monopoly is oppressive, complete, and everlasting.

Upon the whole it appears to us that the present railway system is a curse to this country, and ought no longer to be borne; and we know that thousands are ready to join in the prayer of Mr. Williams' petition—a co-operation which we trust he will render practicable by the preparation of another petition on the subject.

ART. XVIII.—A RHAPSODY ABOUT THE CARTOONS.

COME forth with me, O reader, from this busy, noisy, crushing world, to the bright and placid solitudes of nature. Let us seek out some lonely retreat, where the daisy and primrose smile through the deep green moss, and the silver stream bounds joyously over the pure white stones, to the music of its own sweet murmur, with an unsullied sky above, and a fragrant earth beneath, and the air resonant with the song of birds and the echoes of the distant waterfall. Here let us discourse of art, having first warmed our hearts by the contemplation of nature. This list of the cartoons, which you have of course seen, will supply us with a subject.

The cartoons, taken upon the whole, are certainly little short of a miracle. I felt, on entering the ancient hall in which they are exhibited, as if I were ushered into the presence of some august tribunal. Never, thought I, was this time-worn edifice honoured—scene as it has been of solemn justice-courts and kingly pageants—as now that genius has set his seal of majesty upon its walls. The spirit of poesy was kindled within me. Ay, you may smile, but the subject is, to me at least, full of poetic inspiration. Take a glance at the whole proceedings. A call is made upon native art, with sad misgivings in the minds of many as to the result; the walls of Westminster-hall, literally covered with specimens of British talent, give the triumphant answer. Think how the heart of genius must have bounded at the call. A free scope was now given for his exertions; no mere *name* could step in and obtain the prize. Merit—that is, as far as the umpires' decision would be given with judgment (and how fairly the meed has been awarded we can now well judge)—would not only win, it would gain the prize. Follow the artists, in imagination, to their respective homes. See them pondering over the choice of subject; or, the subject chosen, commencing with zealous ardour the great undertaking. Some of them, bred in the lap of luxury, with ample leisure, and "all appliances" to boot. Others obtaining by their pencil a precarious subsistence, take to the great work by fits and starts, as opportunity serves; the midnight lamp and morn's faintest tint lighting them in their "labour of love." A few solitary individuals, cut off from "life's sweet solace," pursue the work to its completion, with word of encouragement or advice from none. But most, however lowly their lot, have some one friend or more to cheer them in the successive stages of their undertaking. And then the dread interval of suspense between the giving in of the drawings and the announcement of the judges' fiat. What a quickening of the pulse as the time drew nigh! And when the verdict was pronounced, how proudly must the victors—many of them very young men, be it observed—have paced that old hall, seeing their works hung up on high, "the observed of all observers!" Nor were the vanquished in this struggle of art without their meed of solace. The umpires' complimentary expression of regret—uttered, no doubt, sincerely—that they had not more prizes at their disposal, must have tended much to soften down the mortification of defeat. And a still greater solace must it be, to have their works hung, side by side, with those of the victors; thus making the great public also their judges, removing the cause, as it were, into a higher court.

"So then your opinion of those drawings is highly favourable?"

It is. With but few exceptions—very few indeed—and those few have been "cast discreetly into shade," the entire collection is highly honourable to British art. Nothing, certainly, of late years has been calculated to give such a stimulus to native talent as this competition. Infinite credit is due to those who originated and who have so successfully carried out the scheme to its completion.

(*Turning over the Catalogue.*) A thought strikes me on glancing over this list of the drawings, and that is the choice of subjects. I think that some of those allegorical pictures might well have been spared: it is rarely that style succeeds, and it is not suited to the present generation. But what I wished to advert to is, the superiority to national pettiness manifested in the selection of subjects. Thus, among others, there are several drawings, I perceive, of the landing of Julius Cæsar, and of Caractacus being led in triumph through the streets of Rome, or a captive before Claudius. Now, if the French were to have an exhibition of the kind, I question much whether a single Gallic artist would be found to select for his subject an event which involved the defeat of his nation.

"Possibly not. Their *amour propre* would, doubtless, be piqued. But then an ancient Briton is not an Englishman."

True. And what is an Englishman? The blood of a thousand nations courses in our veins. Listen to Defoe.

> "A true-born Englishman's a contradiction,
> In speech an irony, in fact a fiction;
> A metaphor invented to express
> A man akin to all the universe.
> From Pict, Scot, Saxon, Norman, Dane,
> That heterogeneous thing an Englishman began."

And were we derived solely from the natives, still the relationship between ourselves and such remote progenitors would be of so weak a nature that our self-love could not be much piqued by their defeat.

"A very elaborate piece of reasoning, truly: its depth is too profound for me to see the bottom of. With all deference, I beg to doubt the logic of your last two observations. They are two edged, cutting as much against as for you. Surely, the weakening of the ties of consanguinity between us and the ancient Britons must prevent us equally from identifying ourselves with them in their glory, as in their disgrace."

Precisely so. But at the same time, that our nationality ceases to be touched, our universal sympathy with aught that is good or great is appealed to: we regard them no longer as Britons, but as men. And when defeat is dissociated from self, we feel that it is no degradation.

"Very learned and conclusive. But, I fear this grass is wet, so with your leave we'll adjourn the sitting."

ART. XIX.—PROMISCUOUS NOTES ON STEAM-MACHINERY.

Paddle-wheels.—MESSRS. MAUDSLAY and Co. bore out their paddle-centres, and turn a seat for them on the shaft afterwards, fixing them on the shaft with a single key. The plan is a bad one, for two reasons: it is insecure when new, and when old is irremoveable. One of the West India mail vessels, by Maudslay, was almost disabled from this cause on the first voyage, the key on the shaft having slackened, and the centre shifted. And then again, in some of the older vessels, by the same makers, lately under repair at Woolwich, the centres had to be broken off, for they could not be got off in any other way. With this plan of centre we have often known the centres to shift: in one case, the wheel on the weather side was forced against the side of the ship, and the floats, in their revolution, cut deeply into the outside planking.

The best plan of making the centres is with square eyes and square bosses on the shaft, and each centre should be secured in its place by means of eight *thick* keys. The shaft should be burred up against the heads of these keys with a chisel, so as to prevent the keys from coming back of their own accord. If wanted to be driven back, this burr must be cut off, and the keys, if made thick and of the right taper, may then be started without difficulty.

Paddle-floats are usually made either of elm or of pine,—if of the former, the common thickness for large sea-going vessels is about 2½ inches; if of the latter, 3 inches. They should have plates on *both* sides, else the paddle-arms will be very liable to cut into the wood. When the floats have been fresh put on, they must be screwed up several times before they come to a bearing. If this be not done, the bolts will be sure to get slack at sea, and all the floats on the weather side may be washed off, as once occurred to the *British Queen*, on the next voyage after the floats had been removed, to allow the vessel to go into dock. It is a good plan to give the thread of the paddle-bolts a nick with a chisel, after the nut has been screwed up, which will prevent it from coming back.

Most of the London engineers join the paddle-arms to the outer ring, by means of bolts, and a very bad plan it is, for those bolts, after a time, generally become slack sideways, and a constant working of the parts of the wheel is going on. Some engineers again, form the part of the outer ring opposite the arm into a mortice, and they wedge the arms tight in the hole, by wedges driven in on each side. But this, too, is a bad plan, and a very expensive one. The best mode that we have met with is the plan for the most part practised in the Clyde, of making the arm with a long T head, and riveting the cross piece to the outer ring with a number of rivets, not of the largest size, which would weaken the outer ring. Those rivets, in fact, should decrease in size from the centre to each end. The best way of securing the inner rings to the arms is by means of lugs, welded on the arms, and to which the rings are riveted. The plan of making one side of the boss, in which the heads of the arms fit open, is, in our opinion, a bad one. In that case the arms must be held in by bolts, and there is no means of tightening them in the centre. The best way is to let the heads of the arms fit into proper sockets, round the boss, with keys for holding them in and tightening them in the socket, if necessary; and wedge-holes left opposite their ends, by means of which they may be driven back.

Holding down bolts.—This is one of the most important details of a steam-vessel, and one which has by no means met with the attention it deserves. If the foundations of the engines be imperfect, it is impossible that the joints or bearings can be kept in good order. The main holding down bolts should always pass through the bottom of the ship, and should be of brass or copper, so that they may never require renewal. In direct action-engines, from ten to twelve of these bolts will be necessary, and for side lever-engines at least double the number—say four at the cylinder, four at the main centre, and four at the crank framing; twelve bolts for each engine, or twenty-four for the two. In addition to these, there must be a number of bolts secured to the kelsons. These bolts may be fixed by means of nuts underneath the kelsons, provided the bolts are of copper or brass, but if of iron, that plan will not do, as the bolts get quickly eaten away by the bilge water. The only way of dealing with iron holding down bolts, is to tap them into the kelsons, the threads being of course made after the manner of wood screws. The tops of these bolts must be made, not with a head, but with a nut, and a square neck must be left for screwing them in.

It is very important that the cylinder should be secured very firmly to the sole-plate, to which end it should be bolted down all round, by means of a flange, in a manner similar to that whereby the cylinder cover is secured.

Delivery valves.—The kind of delivery valve, of which the seat is driven into the mouth of the air-pump, and firmly bolted there, is a very barbarous contrivance, and appears to have been designed in the conviction that the air-pump bucket never requires to be looked at. Valve-seats when fixed in this way require a prodigious labour to get them out, after they have become firmly rusted in, especially in the case of large vessels. For our parts, we do not much like the plan of having the delivery-valve in the mouth of the air-pump at all, but if they are placed there, they should be of some such construction as that employed by Messrs. Maudslay and Co., which is as follows:—

The top of the pump-barrel is made quite fair across, and upon this flat surface a plate, in which is the delivery-valve, is placed; there being a small ledge all round to keep it steady. Between the cover and the valve-seat a short pipe extends, encircling the air-pump rod, its lower end checked in a little into the eye of the valve-seat, where the rod passes through, and its upper end being spread out, to form the bottom of the air-pump cover stuffing-box. Upon this top some screws press, which are accessible on the top of the gland, and which screws keep down the delivery-valve seat. The packing of the stuffing-box also manifestly tends to the accomplishment of the same object. When the air-pump bucket has to be packed or looked at, it is only necessary to raise the cover, and the valve-seat may be slung with it, and come up by the same purchase. This is the best plan that we know of for fixing delivery-valve seats in the air-pump.

Art. XX.—THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The objects professed by the British Association are, "to give a stronger impulse and a systematic direction to scientific inquiry; to promote the intercourse of those who cultivate science in different parts of the empire with one another, and with foreign philosophers; to obtain a more general attention to the objects of science, and a removal of any disadvantages of a public kind which impede its progress." These purposes are all of them admirable ones; and the result would have no doubt been equally admirable, had the purposes been wisely carried out. But the Association, at an early period of its career, became intoxicated with its own popularity, and of late years, instead of advancing science, its ambition has, to a great extent, been to excite the wonder of the mob. We do not by any means assert, that all of the members, or all of the sections are open to this serious charge. Some of the subjects to which sections are devoted, have but few claims upon the popular admiration; and the more distinguished members of the association can add nothing to their fame by exhibiting their knowledge before a promiscuous assembly; but in the mechanical section, this vice has risen to so pernicious a height, as to have driven away every man of sense and reputation, and the field is left in the hands of certain carpet philosophers, whom every body laughs at, and a host of patentee empirics, who attend to puff their nostrums. Yet this motley group claims to be the representative of the mechanical science of this country, though numbering scarce a single mechanical name entitled to the slightest respect! There is Mr. John Taylor, it is true, Mr. Fairbairn, and one or two others, who, to our astonishment, still continue to attend, and whom we must still respect, although we find them in such bad company. But with these few exceptions, the mechanical section is composed of mere scientific harlequins, who come to the British Association as to a theatre, where they may sport their waves and graces, and put 100*l*. in their pockets.

In spite, however, of these drawbacks, we could not permit the annual meeting of the Association to take place, without being present to watch the proceedings, and to report progress on those subjects of greatest importance, and which were most calculated to interest the readers of the Artizan. The remote part of the British empire, which has this year been chosen for the meeting, tended materially to diminish the numbers of scientific men, who usually honour the meeting with their presence, and the deficiency of ordinary members is no less apparent. This will have a material effect in diminishing the funds of the Association. Last year, at Manchester, the receipts amounted to upwards of 2000*l*.; the receipts at Cork have not exceeded 700*l*. The effect of this falling off has necessarily been to diminish the sums annually granted for prosecuting scientific experiments. The reports of the scientific investigations conducted at the recommendation of the Association, and aided by specific grants of money, constitute usually the most important part of the proceedings. It is to these, consequently, we shall principally direct our attention.

One of the most important subjects, in a mechanical point of view, referred for further investigation, was the strength of materials; and at the preceding meeting 100*l*. was granted to Mr. E. Hodgkinson, for continuing his experiments. These experiments he has prosecuted with much ardour and patient industry, principally, however, on the strength of iron; and the results he has obtained lead to important inferences, respecting the deteriorating effects of continued resistance. He was led to believe that the smallest transverse pressure produces an injurious effect, and that even one-fiftieth part of the breaking weight of a bar of iron will effect a permanent change in the elasticity of the metal, as he found that such a weight would produce a permanent "set." The law he deduced from numerous experiments on the breaking points of bars of iron is, that the breaking effect is as the square of the weights laid on; or, in other words, when a bar of iron is weakened, by having to sustain any given weight, another equal weight laid on will produce a quadruple effect, a third weight a nine-fold effect, and so on till the bar breaks, under the accumulation of weights, increasing in arithmetical progression, and of weakness increasing in a geometrical ratio. The results of the experiments made on upwards of 100 bars of metal, show that cast iron cannot be strained, in however small a degree, without effecting a permanent change in its internal constitution. Hence few experiments were made on stone and timber; and though they were not sufficient to warrant any general conclusions, Mr. Hodgkinson conceives that these materials will be found to be affected in a like manner by constant pressure. The important inference from these experiments is, that all iron, subject to pressure and vibration, is continually undergoing deterioration; and that the structure of the best fibrous iron becomes in time crystalline, and liable to snap. The subject is one which deserves to be thoroughly examined; for if Mr. Hogkinson's conclusions, drawn from his experiments prove correct, we see a new element of destruction constantly operating, in addition to the commonly admitted decay by time. A curious fact was mentioned by Mr. Scott Russell, in confirmation of the results of Mr. Hodgkinson's experiments. He stated, that in the course of some investigations he was making, it was necessary to stretch a long wire to half its tension; but the wire invariably broke, after having been stretched a week, and it was then found that its internal structure was completely changed, for the wire broke on the least bending. He remarked, also, that metals must always be undergoing internal changes by variation of temperature; for a bar of metal expanded by heat, never contracts entirely to its original dimensions. It seems to us highly probable, that the fracture of the stretched wire might be correctly attributed to change of temperature. A further grant of 100*l*. has been made to Mr. Hodgkinson, for continuing his experiments on the internal changes in materials.

A curious and interesting paper on the application of the laws of sound to the construction of buildings was read by Mr. John Scott Russell, who endeavours first to apply the known laws of sound, so as to place, within a given area, the greatest number of auditors, and, secondly, to establish a newly discovered law of sound, which would account for many peculiar phenomena in its transmission, which are inexplicable, on the hypothesis that the waves of sound radiate, and are reflected, like the waves on the surface of a fluid. In the construction of buildings, with a view to place all the hearers within the sound of the speaker's voice, Mr. Russell proposes that the vertical section of the building should be a curve, drawn from the platform of the speaker to the ground, and thence rising to the roof. To construct this curve, he draws lines, radiating from the mouth of the speaker downwards, horizontally, and upwards. The horizontal basement is divided into equal parts, to represent the usual breadth of a sitting, and vertical lines are drawn from each division. The points where these vertical lines intersect the lines radiating from the speaker, form the required curve, which Mr. Russell calls the isacoustic curve, or the curve of equal hearing. The horizontal section of the building is either circular or polygonal, having the speaker in the centre. Some buildings on this plan, capable of containing upwards of two thousand persons, have been constructed in Scotland with perfect success. This form of construction Mr. Russell contends, is also the best for preventing echoes in large rooms; for the walls are by this means covered with human faces, and the object is thus obtained, which is frequently attempted, by making inequalities in the walls, or by covering them, for the prevention of confusing echoes. The other portion of the paper, respecting the laws of sound, recently discovered, was not of much practical importance. The object of it was to prove that, when waves of sound radiating from a point, are reflected from a plain surface, the reflected waves do not radiate, as in the case of water, but are transmitted in parallel lines; and when the surface from which they are reflected is curved, the waves of sound are augmented. On this principle he explains the transmission of sound along flat surfaces, in consequence of its being conveyed in parallel lines, as in a speaking tube, instead of diverging. The augmentation of sound in whispering galleries is also explained, by the accumulation of these reflected waves. In the discussion that followed the reading of this paper, Sir Thomas Deane, the architect of the Cork Court-house, in which it is very difficult for the Judges to render themselves audible, admitted readily the defect, but palliated it, by reference to eighteen courts in England, in every one of which the position of the Judge is, as at Cork, in the centre of a circle, instead of being placed so as to speak to the circumference. Granting fully the importance of the principles Mr. Russell had endeavoured to establish, yet architects were obliged to pay so much attention to decoration, that it is impossible to carry out with effect any principle which interferes with what is considered architectural beauty.

The most prominent communication made to the British Association at this meeting, was the report of many years' experiments on the forms of ships. For perfecting these experiments, which were conducted by the late Sir James Robison and Mr. Scott Russell, the association has at various times granted sums, amounting to nearly 1000*l*.; and the results of these experiments were now laid before the mechanical section by Mr. Russell, who occupied the greater part of two mornings, in explaining the manner in which the experiments had been conducted, and the practical conclusions founded upon them. He alluded, in the first instance, to the unsatisfactory state of the science of ship-building, and to the numerous experiments which had been made in this and in other countries, with a view to ascertain the form of least resistance for a ship moving through water. All these experiments were, however, on too small a scale; for it was found that the model which moved the fastest through water, did not always prove the best when the same shape was adopted on large vessels. In the experiments conducted at the instance of the British Association, they were first made with models, and then verified on vessels of twenty, sixty, and ninety feet long, and also on ships of 1000 tons burden. One cause of resistance to the motion of a ship through water, is the adhersion of the fluid to the sides of the vessel. The amount of this resistance was estimated by Colonel Beaufoy, who performed numerous experiments on the subject, at half a pound for each square foot of surface in contact with the water, when moving at a speed of ten miles an hour, whatever th shape thee vessel might be. This result, obtained with great care by Colonel Beaufoy, was taken for granted by Sir James Robison and Mr. Russell. The great question which they endeavoured to solve was, the particular form to be given to a body of a given weight, to cause it to move through water with the least resistance. Mr. Russell, after noticing the various and contradictory opinions entertained on this subject, by the most experienced ship-builders, some of whom place the greatest midship section in the middle of the ship, others towards the fore part, and others again more aft, explained the precautions which he had taken to avoid all sources of error in the experiments, performed with models of every shape. He and his coadjutor, in the first place, procured models of the most celebrated vessels, made of the same size, and tried them against one another. After trying several models, they had vessels constructed on a large scale, after the forms of those which moved with the least resistance. These vessels were tried against each other at the same time, and were drawn at different velocities by a steam-boat; a dynamometer being attached to each to estimate, the tractive force required at velocities varying from three miles an hour to seven. The results showed, that the shape which is usually considered the best, viz. a round head and a fine run, or, as it is commonly termed, "a cod's head and mackerel tail," met with the greatest resistance; whilst the boats constructed on the opposite principle, something like the shape of a Thames wherry, went through the water with the least resistance. The great object to be avoided is, the formation of a large head-wave, which operates in retarding the motion of a ship, as much as if it were immersed to the same depth in the water. It was found that the formation of this wave was avoided, by increasing the length of the vessel. If a vessel were required to move through the water with a velocity of seventeen miles an hour, a length of 205 feet would be requisite; the *fore-body*, or the length forward from the widest section, should be 120 feet, and the after-body eighty-five feet. The proportion of breadth to the length does not appear to interfere with the speed, the length being the principal requisite, though of course if the weight be increased, the moving power must be increased in proportion. The addition of a straight piece in the middle, to make room for the engines in steam-boats, does not seem to interfere with the speed. Having thus attained the absolute and comparative lengths requisite for a vessel of high speed, the next question was, to determine the form of the water-line, or of that part of the vessel which impinges on the surface of the water. It would be impossible, without diagrams of the geometrical curves, to describe accurately this form, but it may suffice for the present to state, that the fore-part, from the widest section, is tapered off with a long sharp point, like a Thames wherry, whilst the after-part is much more bluff, though it, also, terminates in a sharp point. One peculiarity of the form of the fore-part, and which is directly opposed to all former notions on the subject, is its being hollowed out, so as to receive the water on each side in a slight concavity. In the experiments with models and with large vessels made on this principle, they invariably beat all others; and as compared with the *codshead and mackerel-tails* vessels, their resistances, when moving at the rate of seven miles an hour, were but as 52 to 129. Not only was it found that boats of the proposed construction are the swiftest in smooth water, but that they are also the best sea-going boats, ship the least water, and have the least motion. The recent researches carried on by the British Association, on the form of waves, threw light on the cause of these boats having so little motion; for it appeared that the shape recommended is that usually assumed by the waves themselves; it was assumed, therefore, by Mr. Russell, that as the vessel is adapted to the form of the waves, there must necessarily be less agitation and resistance. The best proof, however, of the excellence of the forms recommended, is to be found in the fact, that the ship-builders on the Clyde, where these experiments have been carried on, have adopted the new principle, and that twenty steam-ships are now constructed in this form, and are all of them first-class boats, and have the highest reputation for speed, and as good sea-boats. Mr. Russell entered at some length into the question, of the kind of resistance offered by the particles of water to the progress of a boat. These are little else than a repetition of the same old story, brought forward as a new discovery every year, for the last eight or ten meetings of the Association.

As regards Mr. Russell's evergreen discoveries, it is not necessary to say much, as people have already learned what weight they ought to attach to his facts and discoveries. We may however mention, that those of the West India mail-vessels, which are built on the wave principle, are the worst and most uneasy of the lot; and although it is certainly true, that the Clyde builders have tried the wave principle,—and they must try anything their customers require,—they have not persevered in the use of it. We never knew so much quackery in any one thing as in this everlasting wave.

The subject of consumption of smoke was several times brought before the notice of the mechanical section, and elicited much discussion. Mr. Dircks, on behalf of Mr. Williams, explained that gentleman's system of smoke prevention, the main principle of which consists in admitting atmospheric air, at the ordinary temperature, through numerous minute orifices behind the bridge of the chimney, by which means the unconsumed heated gases and carbon, proceeding from the coal, receive a proper supply of oxygen for their combustion, and the smoke is prevented from forming. Mr. Dircks contended, that heated air is, economically considered, prejudicial to the consumption of fuel; because a much larger quantity of the expanded air is required to supply the necessary oxygen, and the preliminary heating process consumes much fuel. The proportion of air required for the consumption of carburetted hydrogen gas is as ten volumes to one. A table of the quantities of fuel requisite for evaporating one cubic foot of water, by Mr. Williams's plan, and by common furnaces, was exhibited, in which the advantage of the former was shown to be as two to one. Next came Mr. Chanter's mode of producing similar effects, by heating the air before admission to the coals. His plan consists in admitting the air previously into an air-chamber, where it is heated; and in the form of the bottom of the boiler, where there is what he terms a "deflective arch," by which the gases given out are deflected on to the burning coal. Another part of Mr. Chanter's plan is, to have movable fire-bars, each alternate bar moving longitudinally in one direction, whilst the intermediate bars are moving in the opposite direction. This constant motion of the fire-bars, it is contended, prevents the formation of *clinkers*, and keeps the bars always clean, for the admission of air. Mr. Juckes afterwards exhibited his furnaces. In one of these the fire-bars form a kind of endless chain, which is made to advance at the rate of one inch per minute. On these bars the coals are spread before entering the furnace; therefore the combustion is constantly going on from the front of the grate, and the gases are carried over, and consumed by the heated fuel. In another furnace, exhibited by Mr. Juckes, the fire-bars revolve horizontally, the furnace being made circular; and when all the combustible matter is consumed, the bars fall down, as they leave the furnace, and deposit the incombustible substances in the ash-pit. Several discussions took place on the combustion of smoke, and the best formation of chimneys, in consequence of the exhibition of these competing furnaces. Mr. John Taylor stated, that in Cornwall the engineers contrive to prevent smoke, by proper attention to the supply of fuel to their furnaces; and he believed that if engineers generally would not neglect that important part of their duty, as was too commonly the case, the smoke nuisance might be remedied, without any peculiar construction of furnace being requisite. Mr. Taylor also stated, that the principle of the furnaces of Mr. Williams and Mr. Juckes had long since been adopted. At Mr. Whitbread's brewery, for example, the plan of admitting the air at the back of the bridge had been introduced twenty years ago. The most important fact elucidated in the course of these discussions, and on which all agreed, was, that the common plan of constructing chimneys narrow at the top is the worst form, and that the shape of an inverted cone is the best for procuring a good draught. Many instances were mentioned of the successful application of this form of chimney, and of the advantage of making the top of the chimnies in private houses funnel-shaped. The glass chimneys for lamps larger at the upper end have also been introduced with good effect.

A first report of Professor Moseley, on experiments undertaken at the recommendation of the Association, for the purpose of ascertaining the actual velocities of the piston of a single-acting Cornish pumping steam-engine, at all points of the stroke, was read. These experiments had been made with Morris's instrument for measuring velocities, the indications being given in curves resembling the epicycloid; and by this instrument, spaces described in the 20,000th part of a second are easily discerned. The experiments were made at the engine at Old Ford, but the results hitherto obtained are of not much moment, and the investigations are still proceeding. Mr. John Taylor described a very simple indicator, adequate for most purposes, which had been invented by a working Cornish engineer. In this instrument a half-second pendulum carries a pencil bearing on a card, which is fixed to the beam of the engine. As the card is drawn up by the shaft of the engine, the pencil on the pendulum forms, by its vibrations, series of curves, and the spaces between those curves indicate the motion of the piston each half second.

Among the subjects brought forward in the physical section, the results of meteorological observations occupied much attention; and many inferences from these observations were suggested; but meteorology is as yet but an infant branch of science, and must be content to collect ideas without as yet venturing to establish laws. It is important, however, in such a state of the science, to prevent preconceived notions from interfering with sound generalizations; and no questionable opinions should be considered as established data. In the barometrical observations it appeared to be taken for granted that the rise and fall of the mercury in the barometer is necessarily accompanied by, and is attributable to, the rise or depression of an *atmospheric wave*. This notion appears to us to be of the most questionable kind, and may, indeed, be clearly disproved in the case of solar and lunar attractions; therefore we cannot, even in this passing notice, allow such misleading inferences to be drawn, and set forth as established facts.

Communications were read from Sir John Herschell, and by Mr. Hunt, respecting their researches in photography and thermography. Sir John Herschell mentioned a process by which dormant pictures may be produced which are capable of being developed by the breath. The preparation consists of nitrate of silver and ferro-tartaric acid, which, when dissolved and spread on paper, the latter, if placed in a camera-obscura when wet, receives an invisible impression. This impression is fully brought out by the breath. Mr. Hunt's paper referred principally to Professor Moser's production of pictures in the dark. Mr. Hunt is of opinion that these pictures are produced by the effect of heat alone. The experiments hitherto made in this interesting art have not succeeded in producing varieties of colours in the same picture; but as self-coloured images are attainable by different agents, the further researches and experiments, it is reasonably inferred, may lead to the production of a picture coloured by nature.

Were we to attempt to report, however incorrectly, all the subjects brought before the notice of the British Association at the recent meeting, we should far exceed our limits. We have endeavoured to give a brief sketch of those matters which we considered would prove of most interest to our readers, and to intersperse our account with the remarks which suggested themselves at the time.—The general committee, at its last meeting, granted 1877*l.* for prosecuting various scientific investigations; and as the money received in Cork is only 750*l.*, the balance must be abstracted from the capital of the Association. The next meeting is appointed to take place at York, in September, 1844.

ART. XXI.—THE SOCIETIES.

French Academy of Sciences.—Though the "season" of the learned Societies in London has utterly closed, the Parisian *savans* continue their weekly sittings with undiminished vigour. On the 17th of July, M. Peligot read a memoir on the nature and properties of tea, which excited much attention; the object of it being to prove that tea contains a large portion of nutriment. The most remarkable products from the analysis of tea-leaves are, 1st, tannin; 2nd, an essential oil, which gives the aroma to oil; and, 3rd, a substance containing a large quantity of nitrogen *théine*, which is found also in coffee. M. Peligot ascertained that pekoe tea contains 6·58 per cent. of nitrogen; gunpowder tea 6·62; and souchong 6·15 per cent.; which is a much greater proportion of nitrogen than has hitherto been detected in any other vegetable. The proportions of the products soluble in hot water vary materially according to the age of the leaves: black teas contain, on an average, 38·4, and green teas 43·4 per cent. of matter soluble in hot water. One important fact announced in this memoir by M. Peligot is, that the tea-leaves, after having all the soluble matter extracted by boiling water, contain a quantity of nutriment which hot water alone will not extract. By submitting the used leaves to a heated weak solution of potass, a brown liquor was produced, from which, on the addition of an acid, there was an abundant precipitate identical with the *caseine* of milk. In some countries the leaves of tea are eaten as vegetables, mixed with butter and corn, after the infusion of tea has been obtained. It is estimated that about one-third of the *théine* remains in the leaves after they have been used in making tea. It is estimated by M. Peligot, that an infusion made with 20 grammes of gunpowder tea, and 1 litre of water, produces 6 grammes 33 centigrammes of soluble matter, and containing about 1 gramme of *théine;* and that when sugar is added about four times the weight of the tea, the mixture contains more nourishment than the same volume of ordinary soup.

ART. XXII.—INVENTIONS OF THE MONTH.

Electro-Metallurgy applied to Ship-building.—A plan for the application of the electrotype on a large scale has just been patented, in which the inventor undertakes to copper ships by the deposition of the metal, by electric agency. This plan, we understand, is to float the ship in a basin filled with solution of sulphate of copper, and having previously covered the wood with plumbago, and connected it with his voltaic batteries, the copper will be deposited till it is of the required thickness. The great difficulty to be contended with in this, as in most other processes of electro-metallurgy, is to obtain a cheap electrical agent; for it has been found that the cost of electric labour is, in most cases, fully equal to that of manual; and that has been the cause of the failure of the plans hitherto invented for manufacturing copper vessels by electro-deposition. Should the terrestrial electricity excited in the manner discovered by Mr. Bain prove effectual for these purposes, much of the expense would be saved, and such *formations* of copper (we cannot call them *manu*factures) might become practically available. It is only one step in advance from coating the bottom of a ship to making the ship itself; and if the one plan be found practicable, the other will not be long in arrear. The art of electro-metallurgy is, in truth, full of promise, which, as facilities for the operation are increased, will be progressively realised.

New Process for obtaining Wax and Oil.—We have hitherto had recourse to the vegetable kingdom and to the inhabitants of the sea for wax and oil; but by a new process, recently adopted in North America, we may expect land animals also to furnish their quota of these products. It was stated by Mr. Hawkins, at the meeting of the British Association for the Advancement of Science, that it has become the practice of the back settlers of the United States, who live too remote to convey their pig-produce to market in the shape of food, to boil the pigs up entire into lard, which is afterwards separated into *stearine* and *elaine.* The *elaine* thus produced is found to be superior to spermaceti oil for lubricating machinery, for which purpose it is therefore peculiarly adapted. The *stearine* resembles spermaceti, and makes very good *wax candles.* The usual plan adopted by the back-settlers is to drive their pigs into the woods for a few months, to feed on the acorns, &c., and then to fatten them for a month on Indian corn; after which every portion of their flesh yields so much fatty matter, that it is found more profitable to boil it all, not excepting the hams, than to send it to the provision market.

Self-governing Voltaic Battery.—We noticed, last month, a voltaic battery invented by Mr. Bain, for the purpose of maintaining the electricity developed at a constant quantity. He has since made another, on a different principle, which acts without any clock mechanism. It consists of two earthenware vessels, one placed above the other. In the lower vessel is a voltaic battery on Professor Daniel's principle. The sulphate of copper is, however, packed between copper plates, in a *dry* state, and the battery cannot be brought into action until the metallic salt is dissolved. The upper vessel contains water; and an electro-magnet, connected with the battery, attracts a piece of iron which closes a valve, and cuts off the supply of water to the lower vessel. As the surface of metal brought into action depends on the supply of water to the battery; and as the supply is regulated by the power of the electro-magnet, the force can be maintained, for a considerable period, at any degree that may be required. The operation of the instrument is facilitated by the addition of an index, which directs to the distance at which the electro-magnet is to be set for obtaining any required force.

ART. XXIII.—ANALYSIS OF BOOKS.

Ancient Egypt. Her Monuments, Hieroglyphics, History, and Archeology. By R. GLIDDON, late United States Consul at Cairo. New York: Winchester, 1843.

WE expected to have found in this work a number of new discoveries relative to Egyptian antiquities, such as the peculiar facilities possessed by Mr. Gliddon for the acquisition of information might have enabled him to achieve. In this expectation, however, we have been disappointed, and instead of new discoveries, we find little else in Mr. Gliddon's work than a clumsy digest of the discoveries of other persons. Such a work as his, indeed, might as well have been written in the wilds of America as in Egypt.

There is a singular inelegance in the writings of all these Americans, which cannot fail to give offence to persons of a cultivated taste. Mr. Gliddon's book has a fair proportion of the barbarisms and vulgarities from which few of his countrymen are free. It is extraordinary that they cannot manage to write better, with such examples before them as Franklin, Channing, and Washington Irving.

Guide to Hayling Island, near Havant, in the County of Hants, opposite the Isle of Wight. Hayling: Royal Victoria Library. London: Richard Spencer.

This guide is a very well executed little work, and if its representations be faithful, which we have no reason to doubt, Hayling must be a very delightful spot. Its situation is one of increasing importance.

Practical Directions for the Preparation of Aerated Waters, by Bakewell's Patent Apparatus. By ROBERT VENABLES, M.B. London: Knight and Sons, Foster-lane, 1843.

Bakewell's soda water apparatus is a very neat and convenient contrivance, by which every one may make his own soda water, at a very trivial cost. The construction of the apparatus could not well be explained without a diagram, but it is simple, safe, and effectual. The machine takes up very little room, and its cost is insignificant.

ART. XXIV.—MARVELS OF THE DAY.

The Prince of Wales.—This favourite steam vessel met with an accident the other day, of rather a grotesque character. Coming up from Margate a side lever broke, and the broken end of the lever turning upside down, punched a lever through the bottom of the vessel. The effect of this was to fill the compartment of the engine-room very shortly with water, to the same depth as the water outside, and this before the passengers left the vessel. An inadvertence on the part of the people on board caused some anxiety; this was that a plug in the after bulk head was left out, and could not be found in the hurry of the moment until the water had covered the hole. The hole, however, was soon stopped, and the vessel continued to float with perfect safety; although the engine-room was full of water, and a small quantity in the after compartment. Before the plug of the after compartment was found and put in its place, the crew, as a wise precaution, had hauled the vessel into shallow water; but after this the vessel was towed up with all the water in her, and put into Mr. Pitcher's Dock.

The Glaciarium.—We have paid this extraordinary place a visit, and from all we could see and learn, we certainly think, that the imitation of ice is very successful. An exhibitor performed sundry evolutions, with as much ease and efficiency as could have been attained on ice of the ordinary kind, so that so far as the amusement of skating is concerned, the Londoner will hereafter be as well off as if he resided at Spitzbergen. The ice, we understand, is composed of various salts, one of the chief of which is alum. It can be made of any degree of hardness, but a moderate hardness is found to be best, as when very hard the skate is unable to attain a proper hold, and the skater will probably fall. This evil, however, might be obviated by the use of a sharper skate, and we should prefer that alternative to the one of making the ice soft, by which its surface is soon deeply cut and disfigured. The traces of the skate, however, may be obliterated by washing the surface over with water.

The Chinese Exhibition.—This marvel has exceeded our expectations. We were at a loss to imagine what in the shape of cups and saucers could be found to fill so large a space, or in the absence of those utensils, what thing or things Chinese could be employed to fill their place. Even now, that we have been at the exhibition, we are not certain that we can solve that doubt, not from the want of objects but because their multiplicity has obliterated all distinct recollection of particular ones. The first objects visible on entering the door, are sundry great Chinese idols with candles burning before them. Opposite to this is a linen-draper's shop, which we can imagine to be an exact transcript of one at Canton. In different compartments along the sides of the room are a variety of figures illustrative of the costumes, appearance, and modes of life of the Chinese, and at the end of the room is a magnificent saloon, representative, we suppose, of the drawing-room of a Chinese grandee. Beasts, birds, fishes, paintings, implements, and a host of other *et ceteras* fill the remainder of the room, and so thoroughly Chinese is the whole, that one can scarce visit it without catching the Chinese infection, or having his affections warmed towards cups and saucers. We understand Father Mathew has been visiting the place, and well he may: we know of no more insinuating auxiliary to tee-totalism.

There is one fault, however, we must find, and that is with the figures. We know not whether they are made of wax, or what the composition may be, but the faces certainly do not look like nature, not even like what we can imagine of Chinese nature. The faces want Madame Tussaud among them. Any one visiting her exhibition, and this in the same day, cannot have failed to remark the defect to which we refer. This, however, is but a small drawback to the high gratification a visit to this collection affords.

From our own Correspondent.

MANCHESTER.—*Inundation of the Pendleton-deep Coal-mine.*—One of the greatest misfortunes that could have happened to a prosperous and promising mining concern, occurred a few weeks ago in this vicinity, by the unexpected influx of a large body of water into several collieries on the north-west side of Manchester, whereby great numbers of workmen have been suddenly deprived of employment, although the loss of life has not been extensive. The concern that has suffered most is the Pendleton colliery, belonging to J. Fitzgerald, Esq., well known from its extraordinary depth—above 500 yards—and from its being the scene of some interesting experiments and speculations on the interior heat of the earth, by M. Arago and others. This calamity is the more to be regretted, as the apparatus for the under-ground working, &c., had only recently been finished; and the very superior and scientific arrangements for the ventilation and working of the mine generally were the subject of just encomium amongst mining engineers, and were at the time of the accident in highly successful operation. The unwatering of this mine, at a moderate expense, now presents a problem of no common difficulty, although the greatest influx of water takes place at about 136 yards down the main shaft, the shaft itself being 460 yards deep. The flow of water is estimated at 3000 gallons per minute.

Plate XXV

CRADLING FOR DOMES.

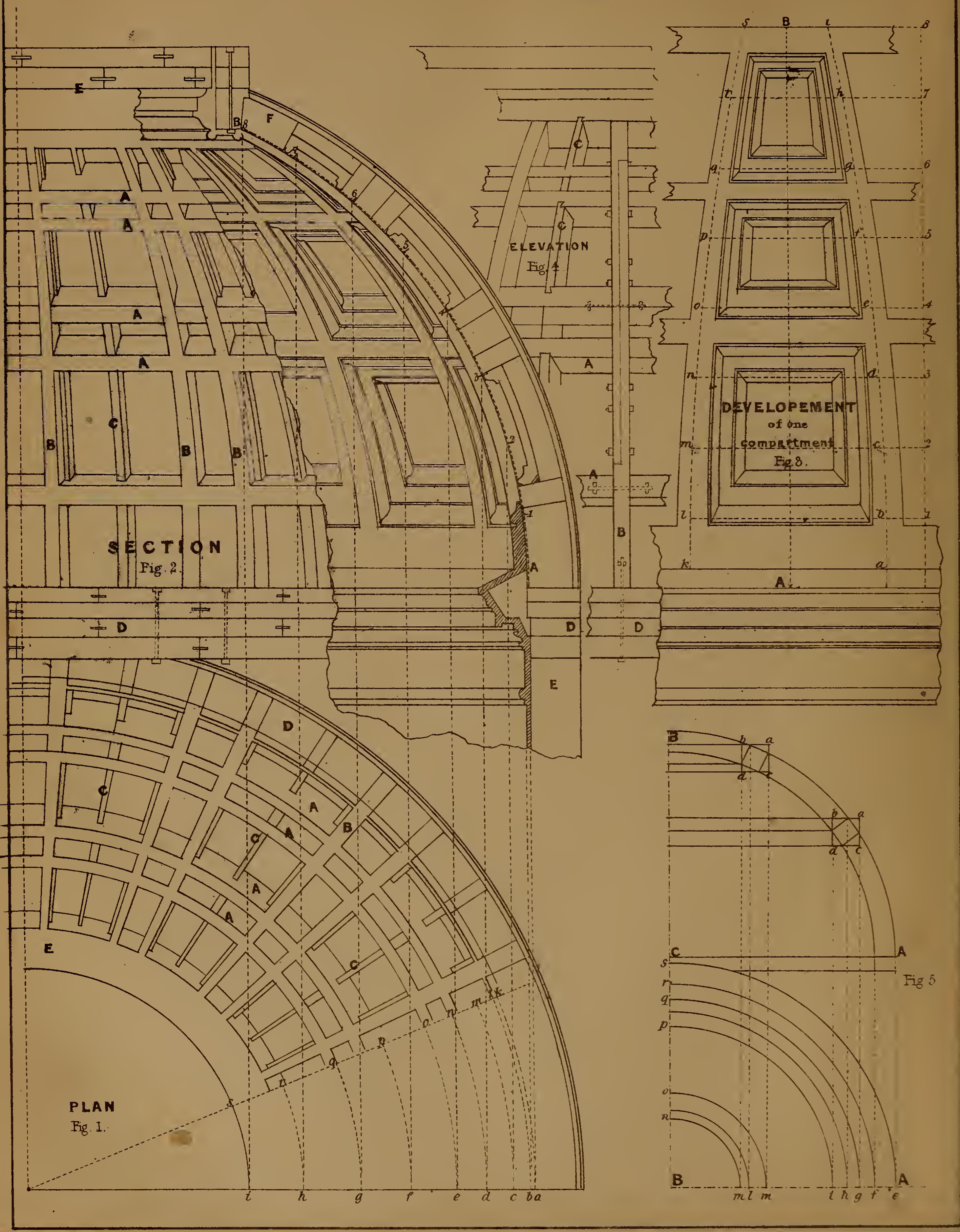


Plate XXVI

ARCHED GROINS.

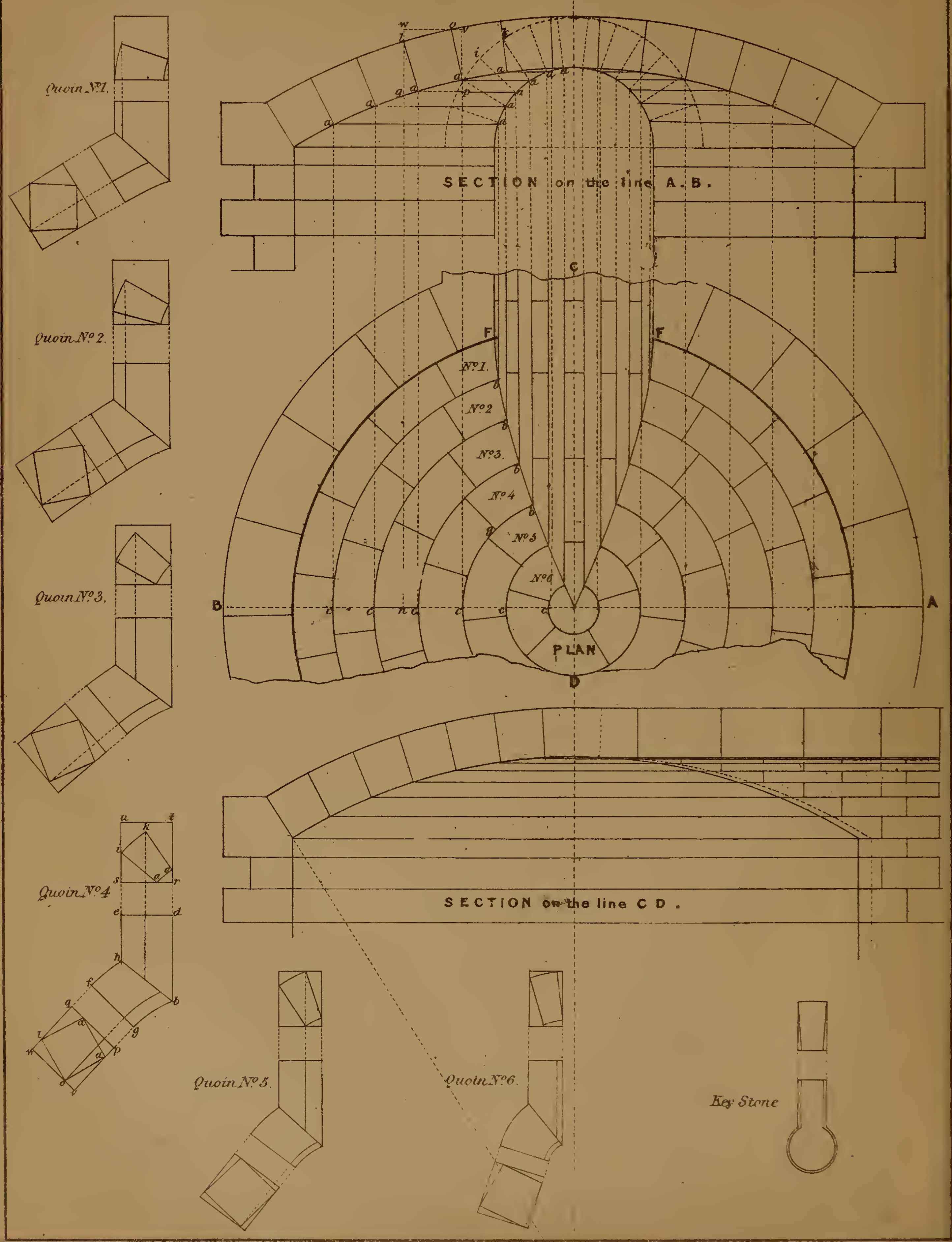


Plate XXVII

WHITELAW'S WATER ELEVATOR.

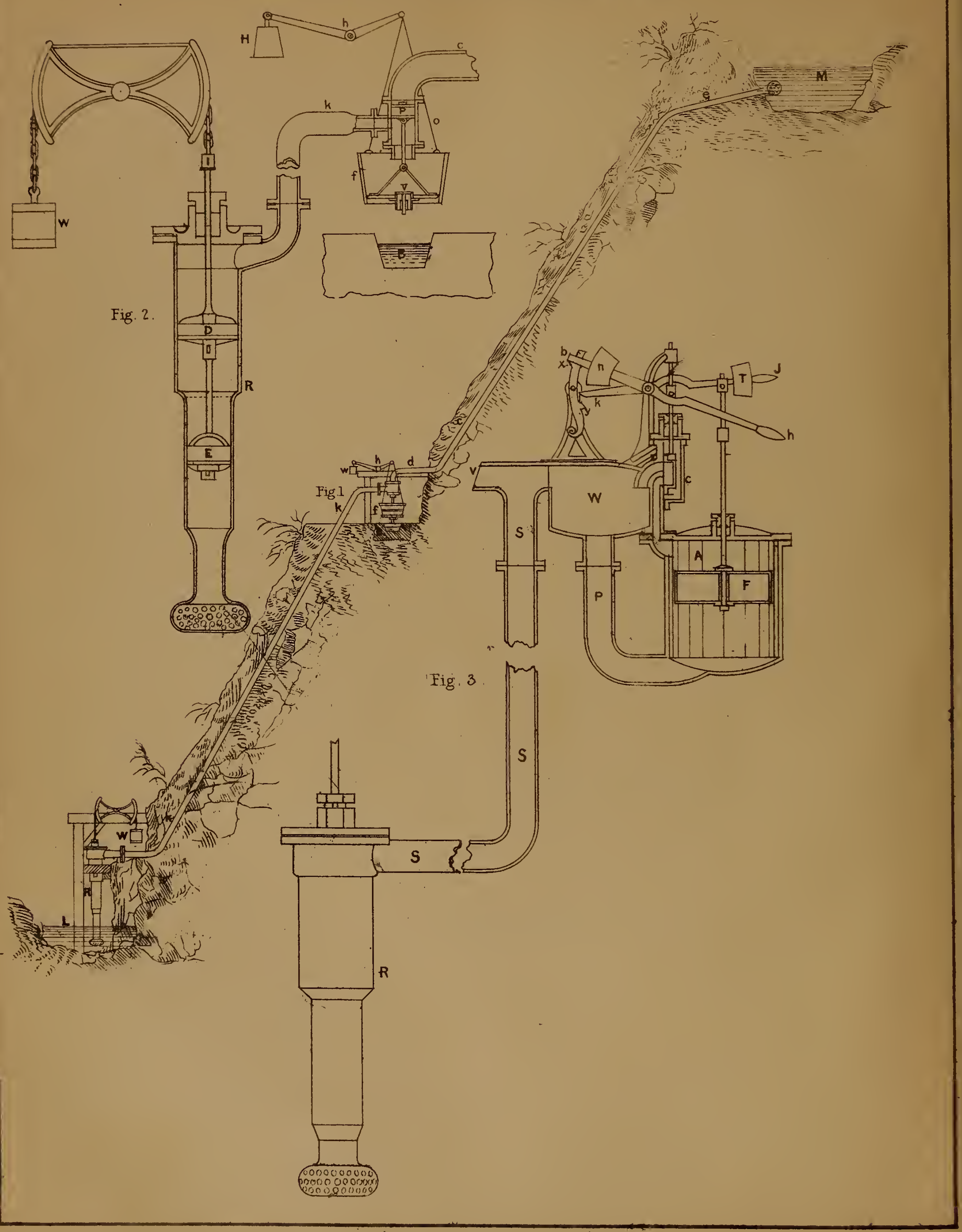
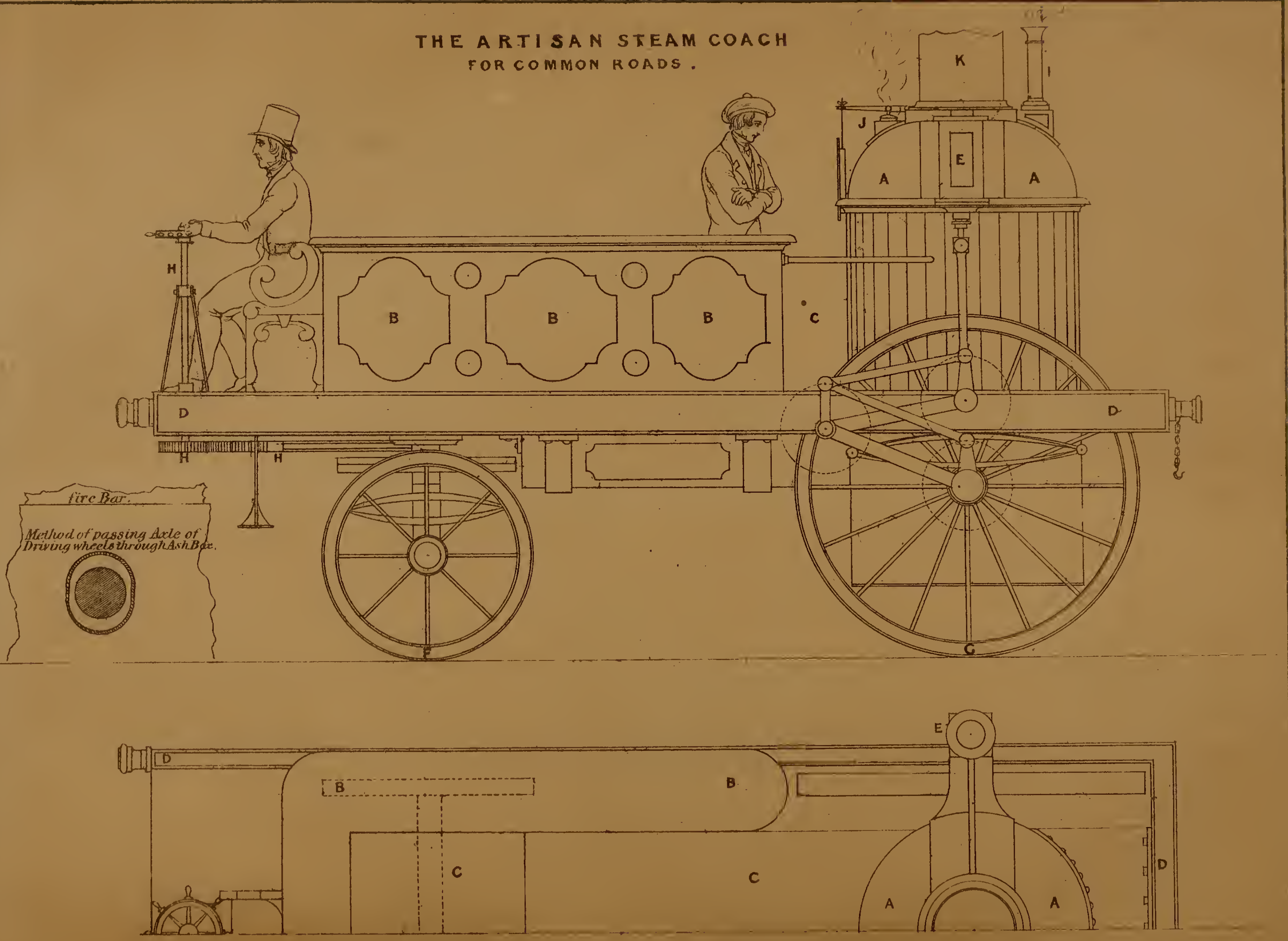


Fig. 1

Fig. 2.

Fig. 3

THE ARTISAN STEAM COACH
FOR COMMON ROADS.



THE ARTIZAN.

No. IX.—SEPTEMBER 30th, 1843.

Art. I.—THE ARTIZANS' INSTITUTE.

We have hitherto refrained from bringing this Association under the notice of our readers, being desirous that a sufficient time should elapse after its foundation to show distinctly what complexion it was likely to assume. Associations of working men have so often turned out ill—are actuated sometimes by such narrow views, and kindle at other times so much hostility towards employers, and dissatisfaction with a humble condition, that we are naturally distrustful of such assemblages, even when congregated for the most specious of purposes. Societies that begin well sometimes dwindle, in the course of a few meetings, into mere scenes of violence and confusion, from which the discreet and temperate man is obliged to retire, leaving the field in the possession of a set of boisterous and hair-brain demagogues. In fact, the ruling vice of associations of workmen is, that the most violent man is generally the most acceptable counsellor, and acquires an ascendency which is sure to end in the ruin of the confederacy, and almost as surely brings upon artizans, whether sinless or sinning, the contempt or hatred of the other classes of society.

It is easy to conceive, then, that any association of workmen, if founded upon an improper basis, or injudiciously conducted, instead of being a benefit to any party, must become a universal curse; and upon no class would the weight of injury fall so heavily as upon the workmen themselves. The misdeeds of the association would be visited upon the class to which it belonged, and of whose spirit and opinions it would be supposed to be representative: and every act of weakness or wickedness of which the association stood convicted would go far to hold up workmen in general to the scorn and derision of an indiscriminating world. It is obvious, therefore, that if any such association be once begun, it is the interest, and indeed the duty, of the discreet and skilful men of every trade either to endeavour to bring it at once to a close, or to add their efforts to those of their fellows, to the end that it shall be wisely and beneficially conducted. In the present case, the latter is the recommendation to which we incline; for, of the advantages of an Artizans' Institute, if judiciously managed, we are highly sensible; and, in spite of our natural incredulity, we are obliged to confess that the present undertaking promises to be attended with a completely successful result. The past year has afforded us abundant opportunities of investigating the principles upon which the Institute is founded, and of noticing the spirit in which it is carried on. To both the one and the other we are obliged to give our approbation; and the length of time over which our observations have extended will probably add corresponding weight to our conclusions.

It is right, however, that we should enable every reader to form an opinion for himself upon this subject, by stating in some detail what the acts and purposes of the Institute actually are. But, in order that the less intelligent portion of our readers may succeed in forming a just estimate of the value of these achievements, we must in the first place briefly indicate the necessities from which the Institute has arisen. The chief of these is the great want of employment, which in most trades, for some years past, has pressed upon the working man with such dreadful severity. The pressure of this evil induced some of the more respectable men of different trades, a considerable time ago, to unite in a common effort to find employment for their unemployed fellow-workmen in other countries, every channel to employment in this country being already filled up. But they soon felt that the recommendation of men to foreign employments was an act of much responsibility, and that it was quite impossible that their recommendations could be indiscriminate if they wished them to continue efficient. In other words, it became plain that if unemployed persons were to be recommended in their turn, and without reference to capacity, persons might be sent to fill situations, to the duties of which they were unequal: the effect of which would be, that no person abroad would accept the recommendations of the Society; and their power of benefiting their fellow-workmen would be entirely cut off. It was obvious, therefore, that their recommendations, to be either honest or to continue successful, must be restricted to persons whom they knew to be competent: and as it would be often impossible to hold any examination, or ascertain the competency of a person at the exact juncture when he might be called to fill a situation, it became necessary that these points should be ascertained beforehand, so that there might be no difficulty or delay. The election to situations would thus be exclusively made from persons who had already passed their probation, and whose competency was sure: in other words, no one could be chosen who was not a member of a select society. That select society has by degrees expanded into the Artizans' Institute, the members of which alone are eligible to be recommended to vacant situations.

We are sensible that, in the eyes of many persons, the plan of a select society will appear an unjust and invidious one. The benefits of which the Institute is productive should, it will be contended, be thrown open to all; and to keep them shut up for the aggrandisement of a select few, is nothing less than a scandalous monopoly. These reasoners, however, forget that the benefits in question are of such a nature, that, if thrown open to all, they would be dissipated altogether. Nor can there be said to be a monopoly, in the common sense of the word, when every man, by diligence and good conduct, has it in his power to obtain a part in the coveted possession; for there is no man who may not command his election on the production of proof that he is a person of skill in his particular art, and of general good character. In this respect, indeed, the Institute stands on the same broad principle as every other useful society—the Royal Society, for example, or the Institution of Civil Engineers: and who is there that pretends that these Societies should be thrown open to all the world without limit or discrimination?

These great principles being duly settled, it soon became obvious that the Society must be one of that species which meet occasionally for mutual instruction; by which means alone the relative proficiency of the several members could be made apparent. Independently, moreover, of the furtherance of the immediate purposes the Society had in view, the discussion, by practical men, of the various practical difficulties which they had found to arise in their respective trades, would, it was felt, be productive of the most beneficial effects—both adding to the present information of every member, and quickening his observation in time coming. Hitherto there has been no source from which practical information relative to the useful arts might be derived; for, although Mechanics' Institutions have been found to be valuable instruments of knowledge, it is only the rudiments of knowledge that they ever can communicate. A workman never expects to acquire at a Mechanics' Institution any material accession to his information relative to the practical details of his own art, although that is the kind of information he is most desirous to acquire, and which is the most valuable to him. Indeed it is impossible to find an instructor of the requisite skill to add materially to the information of a skilful workman in his own particular line; and it is only by a multitude of minds consenting to pour their knowledge into one common stock, that each can acquire any material accession to his store. Mechanics' Institutions, therefore, though valuable aids to the operative, are fitted rather for the Apprentice than the Artizan: they are schools, in which the rudiments of science are excellently taught, and where sound general views are imparted; but they have no direct tendency to make a workman in any trade a more skilful workman, or to bring about the end which every one aims at—the acquisition of a thorough mastery of his particular business. Knowledge, of this quality, is only to be elicited in the conflict of skilful minds; and the lights thus struck out will not merely dissipate the darkness which waits on the condition of the uninitiated, but add to the lustre of the most consummate proficiency.

There is one difficulty which we apprehended would stand in the way of this mutual transfer of intelligence, arising out of a sordid and narrow spirit, by which the more shallow part of our workmen is animated, and which has alternately excited our pity and our shame. Any little information these selfish beings may happen to possess they are loath to communicate, because, indeed, they are unwilling that others should become as wise as themselves. They therefore hoard up certain imaginary secrets, with which, nevertheless, thousands are conversant, as if they were the sole depositaries of these mighty mysteries, and that nobody else had a right to know anything respecting them. It is impossible to help laughing at this miserable spirit, though, indeed, it is entitled to a graver rebuke, as being indicative of a vulgar and selfish heart: but we were not without apprehension that this disposition might go far to embarrass the Institute, although we were sensible enough that it was only by a small and talentless faction that such a disposition was indulged in. We feared, however, that some part of this illiberal tribe might obtain admission to the Institute, with the view of carrying off all the information they could possibly muster, without giving any in return—an event which we apprehended might restrain the communications of the more liberal members, by the way of making reprisals. We are happy, however, to be able to state that, in practice, no such obstacle has arisen. The Institute, we suppose, has been very careful as to the persons it has admitted, or, perhaps, the paltry spirit we have mentioned has well nigh expired. But, however this may be, the only difficulty hitherto experienced has been, to enable members to get heard—every one being anxious to make manifest his talents and attainments by as large contributions as possible to the common stock of knowledge.—It is high time, however, that we should state a little more specifically the Institute's constitution and objects.

The Artizans' Institute was first regularly organized about the end of last year; since which time it has been advancing with slow and cautious footsteps towards that high position which it appears destined to assume. Hitherto the members have been less solicitous to add to their numbers, than to mature their plans on so sound a basis that nothing could afterwards shake them. The common fault of such associations is, to rush on with wild precipitation, and attempt to carry every measure by the enthusiasm of numbers. Irregular impulses of this kind, if they do not end in immediate failure, at least involve a great deal of undoing before the undertaking can assume a healthy character. In this case, however, we have the opposite extreme; and, although the side of caution is the best side to err on, yet we really think that, in the present instance, it has been carried too far. We at length, however, observe some symptoms of activity, and we trust that the purposes of the Institute will now be fully carried out, and its benefits extended to every workman of every trade, provided only that he be a respectable person, and anxious to improve his condition.

The whole of the trades, the workmen in which are eligible to be admitted into the Institute, are arranged under the three great heads of The Mechanical Arts, The Chemical Arts, and The Fine Arts. Of each of these great branches there are numerous subdivisions. Thus, under the first head come the several trades of Carpenters, Masons, Joiners, Engineers, Plumbers, Watch-makers, &c. Under the second head we have the trades of Dyers, Brewers, Sugar-boilers, Bakers, and, in fact, every trade the success of which depends on chemical principles. Under the last head we have Carvers and Gilders, Ornamentists, Painters, Modellers, and every other trade the highest branches of which must be reckoned among the Fine Arts. Most of the operations under this last head, which fall to the workman to execute, are of course merely mechanical; but the classification is regulated by the highest principles of the art, which are those towards which the workman should aspire. Each trade has a chairman, secretary, and committee of its own, and chosen by its own members, by which the selection for filling situations either abroad or in this country is made; and the chairmen of the several trades or sections constitute a supreme council, by which the general business of the Institute is conducted. This constitution is, we think, a very happy one. In the first place it secures unanimity and concert, at the same time that every trade is allowed as much latitude as is consistent with the well-being of the whole; and the council, composed of the chairmen of the several trades, constitutes a court of appeal, which secures every section against any mal-administration on the part of its own officials—precluding favouritism, and obviating the introduction of irrelevant topics or ineligible persons. It is in the want of some such superior court that the complaints brought against most operative societies hitherto founded, and the illegitimate courses into which they have often been betrayed, have for the most part had their origin. Some noisy and ambitious pretender has generally managed to get sufficient influence to rule the society, not for the general interests, but for his own individual gain—an event impossible in this case, as any such aspirant would at once be put down by the general council. Then the composition of the council is so heterogeneous that it cannot be supposed to participate to any considerable extent in the contests and ambition of any particular section; nor is there any temptation to profligacy in the council itself; for, with the exception of appeal cases, it has only to do with general principles, out of which no personal gain is obtainable.

The members of the several sections or trades of which the Institute consists are divided into grades or degrees, of which the lowest is merely probationary; and the highest is reserved as a special honour for those few persons who have attained the very highest eminence in science or art. Between these extremes there are two intermediate stages, the lower being representative of that degree of proficiency which appertains to a skilful workman; and the higher, of that greater measure of skill of which a foreman should be possessed. In other words, these two degrees are the ranks from which workmen and foremen may be respectively recruited; and the Institute will not recommend for a situation of foreman any person who does not belong to the higher class. The higher class is elected from the lower class by the lower class itself; and these elections are only valid after the persons elected have undergone an examination touching their capacity by examiners appointed for that purpose.

Every section meets once a-week; and it is a condition of becoming a member, that a paper shall be contributed yearly to the particular section into which the election is made, treating of some point of practical interest to that section. These papers are read at the weekly meetings, and a discussion is afterwards held relative to their contents, when every member is entitled to state his opinions. From these discussions the greatest advantage is found to arise, for they all have a practical bearing, and the truth is generally elicited in the conflict. As most of the members are necessarily deficient in literature, they are empowered to claim the aid of the secretaries of their respective sections in drawing their papers up. The secretaries being all young men of good education, are perfectly competent to this task, and in every case are eager to undertake it.

From what we have stated it will readily be observed that the Artizans' Institute in no way resembles a benefit society, a trades' union, or any other species of society which has heretofore been formed by working men. Its constitution resembles more closely that of the Institution of Civil Engineers, or of the Institute of British Architects; with this addition, however, that it is one of its grand objects to obtain eligible employment for its members. We shall presently explain in what way it accomplishes this, but would now request our readers to bear it distinctly in mind, that the Institute does not undertake to assist its members with money when sick or out of work, nor does it in any way interfere with the existing benefit societies or any other society whatever. Occasionally, perhaps, it may assist such of the benefit societies with loans or donations as have been impoverished, not by their own mismanagement, but by the pressure of the times: but the Institute itself is no more a benefit society than a Mechanics' Institution is one; nor has it any more connexion with societies of that description. Indirectly, indeed, it may alleviate the pressure on benefit societies, by finding employment abroad for some of their unemployed members; but this benefit is one merely incidental to the working of the plan, and it will arise only in those cases in which the members of the societies in question are also members of the Institute.

The subscription to the Institute is, we believe, a shilling a month—a marvellously small amount for the attainment of benefits such as the Institute offers; but what is still more surprising, the full value of this subscription is returned monthly to every subscriber in the form of printed minutes of the proceedings, and other works of utility; so that there is in reality no subscription, in the proper sense of the term, at all, but only a trifling monthly purchase. From this source, therefore, the Institute derives no revenue; and it will naturally be asked in what way the income necessary for the support of the Institute is realized. We do not know that we are altogether warranted in going into any such explanations, yet we think it right that all such points should be thoroughly elucidated; and although we are not the proper persons, perhaps, to furnish information on the subject, we shall nevertheless hazard a few such general hints as will enable persons of ordinary penetration to understand how a society may succeed in realizing a large revenue without pressing on the pecuniary means of its members by heavy contributions.

In the first place, then, it has been enacted that every person promoted to a situation by the Institute's instrumentality, shall assign to the Institute the wages of that situation for a certain time, in consideration of the benefit the said person has received. The period of this assignment varies with the value of the situation which has been filled up: in the case of workmen, a week's wages is the most that is required; but in the case of foremen or superintendents' situations of value, a month's wages may be demanded. These payments are not left to caprice or accident, but are regulated by a fixed scale, determined on in full conclave; a month's wages being the utmost that in any case can be exacted. A large income is by these means realized for the Institute—not by the contributions of sceptical or unwilling subscribers, who, being already in constant employment, may be doubtful whether they will ever require to avail themselves of the vacancies the Institute has at its disposal—but by the retention, for the benefit of the Institute, of a small portion of the benefits it confers. There is scarce any workman out of employment who will not gladly sacrifice much more than a week's wages to secure for himself an eligible situation; and no workman, in an employment which brings him but poor wages, who would not be delighted with the opportunity of giving a month's wages to secure to himself a situation of great value. And let it be borne in mind that nothing becomes payable to the Institute until the situation has been actually got; and then the payment is so regulated that no inconvenience is experienced. Thus those who have to pay anything towards the Institute, at the same time receive a benefit of far more than equivalent value; so that, in point of fact, the Institute merely exacts a portion of the benefit it dispenses.

Another most productive source of revenue lies in the Institute possessing itself of such patents, by purchase, as are capable of realizing a valuable result; but from the want of practical skill on the part of their inventors, have never been brought to full maturity, and consequently may be obtained on moderate terms. Such practical difficulties as frequently stand in the way of an inventor's progress, are those which an association of practical men may best overcome; and this capacity is greatly heightened when they have the resources, not merely of one art, but of every art, at their disposal. The Institute is of course very careful that it purchases nothing, except what is susceptible of being profitably worked out; and that conviction having been arrived at, the project is handed over to the section to which it more immediately appertains to put it into successful practice. Should difficulties arise in the practical developement of the scheme, the aid of such of the other sections is called in as have analogous principles to work out in their respective trades, or analogous difficulties to encounter. Thus the ingenuity of a multitude of minds, and the resources of every art, are brought to bear upon the difficulties which may attach to the developement of the invention; and under the combined operation of these forces, the most untractable scheme can hardly fail to become moulded into a practical form, and issue in successful improvement.

Such are some of the expedients by which the Institute realizes a large income without oppressing its members by subscriptions; and there are several other resources in its hands, still more productive, but which we cannot now find room to describe. There is one point, however, which appears to require some little explanation, and that is, how it comes about that the Institute has the power to obtain employment for its members? This is a question which every one will naturally ask—it is a reasonable question, and really deserves to be made plain to those who may know nothing of the Institute, except through the medium of these cursory observations. For the benefit of such persons we must squander a few words on this mysterious topic.

And, in the first place, we would beg to remind those who may take the trouble of following us, of the great circumspection exercised by the Institute in its recommendations, to the end that every situation it fills up shall be filled satisfactorily; a condition, on the rigorous adherence to which its whole success depends. This being premised, it is not difficult to understand why persons who have vacancies to fill should apply to the Institute, as they are thus made certain that the situations will be filled eligibly. There are many situations, it is true, for which fitness is not the condition, but favour; and in filling such the Institute would of course have no power, or, even if it had, would, we suppose, disdain to exert it. But in filling all situations for which fitness is the recommendation—and they are by far the greater number—it is not difficult to imagine that the aid of a society will be most willingly accepted, by whose means a fit person will most certainly be selected. In the case of situations abroad, the intervention of the Institute must be peculiarly advantageous. At present, a resident in a foreign country requiring workmen or foremen, has to write to his English correspondent to engage them for him; or else he has himself to visit this country, at great expense and inconvenience, for that purpose. In either case he runs the risk of engaging ineligible persons; and their ineligibility will, in all likelihood, remain undiscovered, until after the expense has been incurred of transporting them to a distant country. By applying at once to the Institute these difficulties are completely obviated, for none but men who are known to be eligible will in any case be sent. In addition to this, the Institute has necessarily a far stronger hold upon the persons it thus sends out than can be acquired by private parties; for if the men it dispatches become lazy, dissipated, or refractory, or in any way break faith with their employer, so as to damage the character of the Institute, which has, as it were, become bound for their good conduct, they will of course be expelled from the Institute with disgrace, and have a blot put upon their names they will never be able to obliterate. There is little danger of misconduct, or of a disposition to take any unfair advantage of an employer, when attended by such a penalty; and foreign employers will no doubt gladly avail themselves of protection against the absurd airs workmen abroad frequently give themselves, by obtaining their supply of men from the Institute exclusively.

But it is not merely to foreign employers that the services of the Institute are useful. Every one who has a situation open which he is desirous to fill eligibly, will naturally go to the Institute. Masters will send there for foremen, and foremen for workmen; and public companies, such as the East India Company, the Steam Association, and in due time, perhaps, the English, as well as the Foreign governments, will send thither for whatever men they may require. This, however, must be a work which years will be required to develope; for people will only be induced to apply to the Institute on account of the conviction, that they will thereby obtain eligible servants, and that confidence is only to be won by a slow and careful progress. Besides this, in governments, and also indeed in large public companies, there is a vast deal of jobbing and patronage, and the question as to how a situation may be most worthily filled is one very rarely agitated. But with masters, and all who are desirous of getting their money's worth, the case is very different, and such persons will come to the Institute to have their vacant situations filled up, simply because it is to their advantage that they should do so.

These hasty observations are probably sufficient to show that the ability of the Institute to find situations for its members is not quite so incredible as it might at first sight appear. The difficulty of getting men to suit situations is quite as pressing as that of getting situations to suit men; a truth to which we can abundantly testify; and it is a relief to us, and no doubt will also be so to numerous other persons, to be able to throw the responsibility of recommendation upon such a body as the Institute, instead of taking the risk of recommending an unworthy person. It is not, therefore, by virtue of any *influence* possessed by the Institute that it is enabled to provide its members with situations, but merely in consequence of its exact knowledge of the character of the persons it recommends, joined to the ever-present conviction that its existence hinges altogether upon the discreetness and honesty of its recommendations. The numerous channels of intelligence, too, it possesses,—pervading as they do every trade of every country,—makes it almost impossible that a vacancy should anywhere occur without the Institute becoming apprized of it; and it is thus enabled to extend its sphere of action, by offering its services in filling the situation up.

Such, then, is a rude outline of the nature and objects of the Artizans' Institute. To some the undertaking will probably appear too gigantic to be capable of a full developement; while others will condemn the whole scheme, as raising up fictitious distinctions among men who are all equal by nature. We do not feel ourselves called upon to answer the objections, whether real or imaginary, which may attach to the undertaking; nor do we suppose the Institute itself is anxious to persuade any one to adopt its views; for the great difficulty, we believe, is in being sufficiently exclusive. We may remark, however, that in our eyes the magnitude of the scheme constitutes its greatest advantage; for, without that, the selection could not be always eligible, nor the intelligence respecting vacancies nearly so extensive. And, as regards the dogma of all men being equal, we at once assent to it, if the equality be held to consist in equality of talent, perseverance, benevolence, and self-denial. In such a case, the regulations of the Institute make no difference between its members; for men equal in those respects are not put by the Institute upon any different footing. But if the equality contended for consists in an equality between the virtuous and the vicious, if it claims for laziness and debauchery the rewards due to honest industry, intelligence, and good conduct, we turn from such a claim with scorn and contempt; for we are sure enough, that nobody but a fool or scoundrel could ever advocate so preposterous a doctrine.

Our readers will probably have by this time gathered from our observations, that of the constitution of the Institute we think on the whole very favourably. Nevertheless we are not without apprehension that mal-administration may in time creep in; that favouritism may arise in some of the sections in the elections to situations; or that turbulent spirits may gain admission to throw the society into uproar. These are only some of the accidents to which every thing human is liable; and in the lapse of years it is certainly possible that they may fall upon this excellent Institution. We trust, however, that there will be found virtue enough among its members, should such abuses arise, to extirpate them at once with a vigorous hand; for there is nothing more obvious, that as soon as the Institute ceases to be honest it must cease to exist. Every precaution, however, has been taken against such calamities, and, in the hands to which the Institute is now confided, there is little danger that they will arise. But it is of the last importance that the chairmen of the several sections should in all time coming be men not merely of skill, but of the most inflexible honesty, who are neither to be daunted from what they know to be right, nor cajoled into ambiguous courses. The several checks which the regulations of the Institute impose are well adapted to detect any such doubtful dealings, and provide an effectual and summary remedy; a traffic in venality cannot, therefore, be carried on very long, except, indeed, on the supposition that the Institute had become utterly corrupt,—a thing not very likely in itself, and one which would speedily work its own reparation. When the temptations to honesty are so great, and the penalties of profligacy so certain and immediate, it becomes less difficult to exercise our faith; and we do trust that the Institute will long continue to show the same integrity and circumspection which have marked its past operations,—a course which must infallibly conduct it to the summit of glory and success.

Art. II.—A FEW WORDS ON THE TRADES OF SHEFFIELD.

Sheffield has been celebrated, for some centuries, as a factory for knives and tools. As early as the thirteenth century, Chaucer mentions the Sheffield "thwytel," or whittle, in such a way as to prove to us its general use and estimation in that day; and, in the sixteenth century, "the Hallamshire whittels had fame throughout the realme." In 1624 a corporation was formed for "the good order and government of the makers of knives, scissors, shears, sickles, and other cutlery-wares, in Hallamshire;" the government of which was vested in a master-cutler, two wardens, six searchers, and twenty-four assistants. About forty years afterwards, the manufacture of clasp-knives, razors, and files, was introduced; and in 1750 we find the trade so increased as to allow of a considerable exportation to the continent. The manufacturers, however, were, in earlier times, more distinguished for persevering industry than enterprise or ingenuity; and the reader may infer the small comparative importance of its manufactures, from the fact that, in 1615, the township comprised only 2207 inhabitants—1400 of whom were paupers; and that, in 1736, with all the increase of trade caused by wars and commerce, the population of Sheffield parish was only *one-eighth* of that returned in 1841, which was estimated at 112,492. The manufacture of plated goods was commenced in the latter part of the last century: goods in Britannia and other white metals have since been introduced: the papier-maché manufacture, type-founding, and other branches of business, have subsequently found their way thither: and all these, as will soon be shown, occupy very important places in the industrial occupations of the town. Indeed, during the last half century, Sheffield has made an astonishing progress in the career of industry; and in many of its manufactures it has no superior,—in some no rival.

We propose to mention a few particulars respecting some of the staple trades, and shall take, in succession, the silversmiths and silver-platers, the saw-makers, the file-makers, the edge-tool makers, and the pocket-knife manufacturers,—premising, that our statements have been collected, partly from information gained by the writer in the town itself, and partly from Dr. Calvert Holland's new work on the "Statistics of Sheffield," which supplies many important facts on the sanitary influence of the various trades peculiar to Sheffield.*

I. The *silver and silver-plated goods* of Sheffield are as celebrated in this country, as its cutlery and hardware abroad. In taste, quality, and exquisite beauty of elaborate workmanship, the Sheffield manufacturers are not equalled in the world; and the annual consumption of these goods in Great Britain (independently of exports, valued at £100,000 a-year,) is estimated at about *a million and a quarter*,—requiring the use of more than 500,000 oz. of silver for their manufacture. The labour is divided among designers, die-cutters, and chasers, (who are always highly paid,)—stampers, braziers, pierced workers, and candlestick-makers;—besides whom, there are cutters-out, polishers, burnishers, and scourers; the three last being principally women. Wages, 36*s.* to 45*s.* for designers and engravers; 21*s.* to 30*s.* for braziers and platers; 6*s.* to 15*s.* for women and boys. The workmen generally are very respectable, more than usually educated, often members of literary societies, and, in almost all cases, members of friendly societies. The number employed may amount to nearly 700, including women and children. The following table, respecting the health of silversmiths, is extracted from Dr. Holland's work, and (if correct) shows that the value of their lives is somewhat above the average of the artizan classes generally.

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* *Vital Statistics of Sheffield, by* G. Calvert Holland, M.D., Physician to the Sheffield General Infirmary. 8vo. pp. 263. Tyas, London: Greaves, Sheffield.—As a work on *statistics*, we confide but little to it, because its errors on these points are great, and quite inexcusable in a resident physician, to whom the mortuary registers, as likewise the infirmary and dispensary reports, were fully open. On the *trades*, however, it furnishes much valuable information, which we know to be fairly correct.

Mean Ages attained by persons dying above given Ages in the Silversmiths' Benefit Society, as deduced from the Mortality of the past twelve years.

Given Age.	Age attained.	Given Age.	Age attained.
20 . . .	46·15	45 . . .	61·97
25 . . .	49·63	50 . . .	64·66
30 . . .	52·95	55 . . .	66·24
35 . . .	56·11	60 . . .	67·20
40 . . .	59·12	65 . . .	69·58
		70 . . .	71·81

II. The *Saw-makers* are an intelligent, sober, and well-conducted class, and better educated than the mass of the working population. Saw-making is divided into three branches,—saw-making, saw-handle making, and saw-grinding. In the first branch there are alleged to be about 210 journeymen; 130 boys, employed chiefly in toothing and filing; and about 30 women, rubbers, scourers, oilers, and wrappers. Day wages, from 24*s.* to 35*s.* a-week:—piece work, ranging between 28*s.* and 42*s.* weekly earnings. There are about 250 saw-handle makers, including nearly 100 boys. Average wages, 21*s.* to 26*s.* weekly. The saw-grinders may average about 200, including 80 apprentices. Wages, by the piece, averaging 45*s.* weekly; out of which are to be paid wheel-rent and wear of stones,—net 40*s.* About nine-tenths belong to sick-clubs, and nearly all are in union. The trade, however, owing to its dependence on foreign markets, is liable to great and distressing fluctuations. The occupation is generally healthy, requiring considerable muscular exertion, and the workmen are on the whole well-formed, strong, and long lived, though occasionally killed or disabled by accidents in grinding, which, however, is always done on a *wet* stone.

III. The *File-makers* may rank, in point of education, providence, and general respectability, with the artizan classes just described; but, unfortunately, the extreme fluctuations of this trade cause great numbers to be frequently out of work. They may be divided into four branches,—forgers, grinders, cutters, and hardeners. There are about 500 forgers, including the *strikers* (who aid the chief workmen); 900 cutters; and perhaps 400 grinders and hardeners,—making a total of nearly 2,500 people, including boys and women. Average wages, in full work: forgers, 32*s.*, and strikers, 26*s.*; cutters, 23*s.*; man and boy, 36*s.*; grinders, 34*s.*; hardeners, 25*s.*; women, (scourers and cleaners,) 9*s.* weekly wages. Boys are employed in file-making at a much earlier age than either in plating or saw-making.

IV. The *Edge-tool trade* requires the investment of a large capital, owing both to the cost of the raw material and the long credit necessary to export trade. The workmen are comprised under three divisions,—the forgers, grinders, and hardeners. In the first division there are about 200 foremen, and 200 strikers, including about 60 apprentices. Average wages: foremen, 34*s.*, and strikers, 21*s.*; very much below what might be earned by steady, industrious men, not given to keep Monday and Tuesday as close holidays. Three-fourths of the work-people are alleged to belong to sick-clubs; but it would be vain to look for intellectual developement in a set of men whose whole employment consists of muscular exercise of the body, requiring little ingenuity. So great, indeed, is the difference in the form of the head in these individuals from that belonging to other artizans, that it would be almost impossible not to remark their low retreating foreheads, and large posterior developement of brain.

V. The *Pocket and Pen-knife makers* are among the humblest, and, too often, the worst principled and most improvident artizans of Sheffield, comprising the great depôt from which paupers are recruited, and giving no small employment to the police for charges of embezzlement, &c. A paltry capital of some few pounds will supply the cutler with inferior metal and cheap tools. Thus men, one day at journey-work, become masters on the next, and every chance of respectability for the trade at once vanishes. This remark applies only to such as supply the hardware dealers, who supply the hawkers and petty shopkeepers; and it would scarcely be charitable to inquire into either the quality of the workmanship, or the mode in which the materials are procured. The following statement, by Dr. Holland, is pretty near the truth: the scale of wages we have ascertained ourselves.

Spring-knife hafters	1400	. at .	12*s.* to 18*s.*
Scale and spring forgers . . .	150	. at .	14*s.* to 20*s.*
Blade forgers	300	. at .	30*s.*
Pocket-blade grinders . . .	100	. at .	26*s.*
Pen-blade grinders	300	. at .	28*s.*
Sundry others, including apprentices .	750	. at .	12*s.*
	3000		average 21*s.*

In times of depression, however, the wages are much lower; and as no part of this trade is in union, workmen may always be found who will work 30 or 40 per cent. below the price paid by the respectable master cutlers.

Fork-grinding is another branch of the Sheffield trades, so nearly allied to the table-knife manufacture, that it would be difficult to separate it; but we are induced to give it a separate notice, from the great danger of the employment. Wet and dry grinding are both in very common use,—the former for saws, scythes, and edge-tools; the latter for razors, scissors, pen and pocket-knives, forks, needles, and other small articles; and wherever dry-grinding is employed, there is invariably a great waste of human life consequent on the inhalation of metallic and stony particles,—the evil being not a little increased by the utter carelessness of the work-people, who seem to set at defiance all humane contrivances for diminishing destructive influences. The dust which arises in the workshops from eight or ten wheels rises in dense clouds, pervading the atmosphere, and thus undermines the vigour of the constitution; produces asthma and lung disease; and kills off the work-people in the prime of life,—often before they have entered their thirtieth year,—very few indeed ever living beyond forty. The fork-grinders are unquestionably the most exposed to these dangers; but they attach, in certain degrees, to every branch of the grinding business, and furnish us with a most melancholy picture of the condition of a very large class of artizans in Sheffield. The following table shows pretty clearly the influence of the six chief branches of the grinding trade on human life, as compared with its mean duration in England and Wales.

Mean Ages attained by persons dying above given Ages, among the several classes of Sheffield Grinders, compared with the same facts in England and Wales.

Given Age.	Saw-grinders.	Scissor-grinders.	Pen-blade grinders.	Razor-grinders.	Needle-grinders.	Fork-grinders.	England and Wales
20	48·68	38·23	32·73	31·88	31·17	29·73	54·97
25	49·33	40·39	36·22	34·87	33·86	32·85	57·52
30	50·50	42·82	39·67	38·09	36·77	36·01	60·60
35	51·97	45·53	43·08	41·53	39·90	39·21	62·55
40	53·77	48·52	46·45	45·21	43·25	42·44	64·90
45	55·88	51·80	49·79	48·73	46·82	45·71	67·16
50	58·30	55·36	53·09	53·25	—	—	69·36
55	61·04	59·20	56·34	57·60	—	—	71·60
60	64·09	63·31	—	62·19	—	—	73·96
65	67·46	—	—	—	—	—	76·49
70	71·15	—	—	—	—	—	79·26

Respecting the almost innumerable miscellaneous trades carried on in Sheffield, as at Birmingham, it is quite impossible to give any details that would be at all satisfactory. We have omitted, likewise, all mention of the very extensive works carried on here for the conversion of iron into steel; in which department, the establishment of the Messrs. Sanderson may rank as the most extensive and celebrated in the world.

ART. III.—WHITELAW'S WATER ELEVATOR.

IN situations where water has to be raised from a depth, it frequently happens that the power requisite to accomplish its elevation is obtainable from a run of water coming from an adjoining eminence. As a simple mode of taking advantage of a fall so situated, the following ingenious contrivance, devised by Mr. George Whitelaw, of Glasgow, may be employed with advantage.

Let R, fig. 1, Plate XXVII., represent a pump, placed at the bottom of a mine or quarry, whence water has to be lifted, and delivered into the gutter; and B c c a pipe for conducting the water from the higher ground to give motion to the machine. In fig. 2 the working parts are shown on a larger scale and sectioned, and with the same letters of reference. The pump R will be seen to have two working buckets, D and E, attached to the same rod. These buckets are mounted in the usual way, their valves opening upwards. To the cock balance *h* is suspended the vessel *f*, into which the water from the pump is discharged, whence it escapes into the gutter B by an opening in the bottom, fitted with a valve V, that opens as the vessel descends. The purpose of this vessel is to work the valve P, which consists of a piston, faced with leather on both ends, so as to form a double valve.

When the valve P is in the position shown, the weight W, by being sufficiently heavy to overcome the pressure of water on the pump buckets, will draw them upwards, so that water will flow into the vessel *f*, until it becomes heavier than the weight H, when it will descend, and shift down the valve P.

This will stop the flow of water into *f*, and at the same time open a communication between the pipes C and K. Thus an additional column will now act on the lower pump bucket, and, from its superior force, cause the buckets to descend, and raise the weight W.

By the time the pump-buckets have descended, the vessel *f* will have got emptied of its water by the valve in the bottom; and being thus relieved of its load, the weight H will draw it up. The valve P then shuts off the communication between the pipes C and K. The pressure of the upper column being now withdrawn off the pump buckets, the weight W makes them rise, and discharge another portion of water into the vessel *f*.

In order that the principle of the machine may be better understood, we shall suppose the perpendicular height from the water in the well at L, to where it is discharged at O, to be 20 feet, and from O to M 30 feet, and the area of the bucket D to be twice that of E.

When the pump-buckets are rising, a column of water, twenty feet high, will be acting on the surface of the bucket D; and to make the buckets descend, we have a column of 50 feet acting on the bucket E. The column, it will be observed, cannot act on the large bucket D; for, during the bucket's descent its valves must be open, to allow a portion of the water that is between the buckets to pass through; but a column, 40 feet high, resting on the small bucket, is equivalent to a column of 20 feet, resting on the large bucket. However, as the weight W must be somewhat heavier than what will just balance the weight of water on the large bucket, so as to be able to set the buckets and water in motion, it will require a column more than 40 feet high on the small bucket, to overcome the extra weight, and force the buckets downwards. Hence we have supposed the whole height to be 50 feet, which leaves 10 feet for the friction and inertia that have to be overcome.

Again; suppose the area of the bucket D to be equal to one square foot, and the area of the small bucket E equal to half a square foot, and their stroke two feet. When the buckets make a stroke upwards, it is evident that the pump must discharge a quantity of water equal to the area of the large bucket, multiplied by its stroke, equal to two cubic feet. At the same time, as the water carried upwards by the lower bucket will only half fill the vacancy formed under the upper bucket during its descent, a cubic foot of water must necessarily rise up through the valve of the lower bucket, to fill the deficiency. As the buckets descend, a cubic foot of water, or a quantity equal to the area of the small bucket multiplied by its stroke, must pass from the pipe *e* to the pipe *k*, while an equal quantity must pass from between the buckets to the upper side of the larger one; so of the two cubic feet of water that are discharged by the upward stroke of the pump, one cubic foot of it is raised from the mine or quarry, the other half being what has passed downwards through the pipe *c*.

It will be observed, that the difference between the size of the pump-buckets must depend on the height the water requires to be lifted, and the height of the whole column, that is, from L to M. To find their relative proportions, let a represent the height the water has to be raised, b the whole column, c the height of a column necessary to give motion to the machine, d the diameter of the large bucket, and e the diameter of the small bucket. Then $d^2 \times a = e^2 \times (b - c)$, or $\surd\ d^2 \times a \div (b - e) = c$.

Fig. 3 shows how the different pumps may be employed to raise water from great depths, with steam as the prime mover. R is the pump, supposed to be placed near the bottom of the mine, and in every respect the same as seen in fig. 2; S S S the pipe leading up the shaft to the vessels wherein the steam operates; A being the steam vessel, which is lined with wood; W the condensing vessel; G slide valve chest, which communicates by a pipe with the boiler. The slide valve, when drawn up, admits steam into the vessel A: when it is pressed down to the position shown, the steam that entered A passes into W. The float F communicates motion to the slide valve by the levers *h b* and *j k*. The machine operates as follows:—The vessels and pipes being full of water, except A, which must be about one-third filled with some fixed oil; on raising the slide valve, the steam enters the vessel A, and forces the water up the pipe P into W; while the water in W partly escapes by the valve V, and part of it passes down the pipe S S S, as the pump-buckets descend from the weight of water above them. The float F, with its rod, at the same time moves downward, carrying along with it the end of the lever *h b*. When the float reaches about half way down the steam-vessel, the projection *b* of the lever comes in contact with the catch *x*; when the other lever, which has been resting in the catch *y*, is set at liberty, so that the weight T, by falling, depresses the slide valve. Thus the steam is shut off from entering the steam-vessel; and the steam that had entered it passes into W, as the water in W descends by its gravity into A. But as soon as the steam enters the vessel W, it must be condensed by coming in contact with the cold water there. A vacuum being thus formed, the counterpoise attached to the pump being now assisted by the pressure of the atmosphere, pulls up the pump-buckets, and fills the condensing vessel with water. The float, on rising with the water in the steam vessel, lifts up the end *j* of the lever *j k*, while the other end *k*, by coming in contact with the catch *y*, in its turn disengages the lever *h b*, which, from its weight *n*, will raise the slide valve, and admit steam into A; when the water will again be displaced, and so on successively; the working of the machine being regulated by the throttle-valve in the eduction pipe 2.

In the case of water having to be raised from such a depth as to require the column to be divided into different lifts, all that is necessary is to place a pump at the different heights; and to connect the lower ends of the upper pumps with the upper ends of the lower pumps, each pump having its own balance weight.

The intention of using oil in the steam vessel is, that it may intervene between the steam and the cold water; and as fluids do not conduct heat downwards, the heat that the oil attains by being in contact with the steam will not descend into the water; nor will the oil lose much of its temperature by occupying part of the vessel alternately with the water; for the wood with which the vessel is lined, being a bad conductor, will not abstract much heat from the oil, nor impart much heat to the water. The oil will also allow a more perfect vacuum to be formed, as no vapours will arise from its surface, its boiling point being much higher than that of water.

ART. IV.—ON THE HEALTH OF THE WORKING CLASSES IN LARGE TOWNS.

No. 2.

THE late Dr. Bateman, in his Historical View of Health in the Metropolis, after comparing its condition thirty years ago, with that in which it was placed two or three centuries ago, when plague and sweating-sickness were wont to kill off a sixth of the population in three or four summer months, and when, even in the intercurrent healthy years, the yearly mortality was as high as 7 per cent., (or 1 in 14·3,) judiciously traces the increased healthiness of London to its true source. "The causes," says he, "of the happy decrease of some of the most fatal and epidemic maladies, and the diminution of the fatality of others, may be in a great measure ascribed to the evident changes in the physical and moral condition of the Metropolis,—from a state of perpetual filth and pollution to the open, airy, well-paved, and comparatively cleanly condition in which it now is, and to the alterations in our domestic economy with regard to situation, ventilation, and cleanliness." Now, we have in our previous article, proved not only an increased mortality in towns over our country districts, but a higher rate in a close pent-up district than in an airy, open one, in the same town; and that too, when the former is within a few hundred yards of the latter, and no cause of aggravation can be found in the climate or situation irrespectively of those *removable* sources of disease,—filth, want of wholesome ventilation, and insufficiency of nutritious diet. Our present object is to open the eyes of the artizans throughout the kingdom to the real state of their fellow-countrymen in their domestic habitations, to expose the dangers they incur from want of ventilation and sewerage, and to unveil the fearful evils—moral as well as physical—that flow out of that guilty inattention to the means of cleanliness by which town-authorities are very generally characterized throughout England; nor is it our intention to make any single statement that cannot be authenticated from official sources. Indeed, the subject is too important to admit of trifling; the facts are exposed to court examination, and most happy, as well as thankful, shall we be if the exposure of *existing evils* may lead to the application of *speedy remedies.*

Our friends will, perhaps, accompany us on an imaginary tour to the manufacturing towns,—those districts that comprise, *par excellence*, the life's blood of our population; and they will recollect, also, that every, or nearly every fact here stated on official authority, is confirmed by the long and painful personal observations of the writer of this article. Before, however, we visit the provinces, let us dive into some of those dreary purlieus of LONDON, where squalid poverty and gaunt disease work hand-in-hand, debilitating, demoralizing, and killing off hundreds of the most useful members of the community; those whose labour and skill have caused England to attain its present high station in respect of manufacturing industry. Within almost a stone's throw of our office, are the filthy confined lanes and alleys debouching into Drury-lane and its adjoining streets; and a little further northwards, lie the close, poverty-stricken districts of Seven-dials, and St. Giles's, comprising courts and entries, the filth and sickening stench of which equal in horror any thing that we have seen either in Dublin or Liverpool, by furnishing lodgment,—if lodgment it can be termed—to thousands of impoverished beings, principally Irish, who, indifferent to better habitation, are content to herd here like swine, regardless alike of health, cleanliness, and common decency;—indeed, it is no uncommon thing to find twelve or fourteen families, comprising, perhaps, sixty individuals, crowded from cellar to garret, in the different floors of crazy tenements, without backyards, without supplies of water, without ashpits, sewers, or drains; in fact, totally destitute of those means and appliances by which the dwellings of civilized men are made cleanly, wholesome, and respectable. The consequences of such a state of things are obvious. The accumulation of excrementitious and other refuse* becomes enormous, dungheaps of gigantic proportions occupy every hole and corner where they may have room to collect, and the effluvia thus generated, being almost undiluted by the pure atmosphere of heaven, but plentifully mixed with the poison of human miasms, become powerful morbific agents, withering the energy of the whole population to its very roots, keeping a *twelfth part* of it constantly on the bed of sickness, *and reducing life to half its usual span.* If we travel eastward or southward, we shall arrive at districts presenting quite as melancholy an aspect. The narrow streets, lanes, alleys, and courts north of Holborn, between Gray's-inn-lane and Smithfield; large portions of St. James's, Clerkenwell, St. Luke's, Shoreditch, Whitechapel, Bethnal-green, and the Tower-hamlets, are constant foci of disease, owing to the entire absence of sanitary provisions. And if we visit Westminster, or cross the river to Lambeth, or Southwark, we shall there find spots equally marked with filth and misery, in the Almonry, Duck-lane, and Old Pye-street, a few yards south-west of the monastic retreats of Westminster Abbey, and Dean's-yard,—in and about Lambeth-marsh, and the New-cut,—near St. George's church in the Borough, and in the whole district of Bermondsey, east of London-bridge. In fact, there are very few quarters in London, however airy or healthy by repute, which have not their dirty neglected streets and lanes, swarming with inhabitants whose very looks exhibit the dire destructive influence of their dwellings. As those quarters, however, which have been just described, contain by far the majority of the humbler working classes of Londoners, we shall present a table of the relative annual mortality in different parts of the Metropolis, arranged according to their comparative unhealthiness.

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* The principal gas rising from drains, cesspools, &c., is sulphuretted hydrogen, two or three cubic inches of which cause instant death when injected into the veins or chest, or beneath the skin of animals. A rabbit immersed to the neck in this gas will die in ten minutes, *though allowed to breathe the pure atmosphere.* Nine quarts injected into the intestines will kill a horse in a single minute. Even when largely diluted with atmospheric air, it is still highly poisonous, for even one eight hundredth part mixed with the atmosphere will kill a dog. A few years ago, four men were poisoned while emptying a cesspool, near Brompton; and still more recently, at a school near Clapham, twenty-three children were attacked, and two died, in consequence of inhaling this gas, from a foul cesspool in the garden, next their playground. Now, although effluvia of this kind, in our wretched courts and back streets, are breathed in a state of comparative dilution, it cannot be denied that even thus inhaled they must be excessively injurious to health.

Registered Districts.	Population.—1841.	Amount of Mortality per cent.
Whitechapel	71,758	3·87
St. George's, Southwark........	46,622	3·30
St. Giles' and St. George's......	54,250	3·17
St. George's in the East........	41,351	3·14
Bermondsey..................	34,947	3·12
Shoreditch	83,552	3·09
Westminster	56,718	3·08
East and West London	73,284	3·08
Holborn	39,720	2·95
St. Olave and St. Saviour	51,407	2·93
Bethnal-green	74,087	2·93
Rotherhithe..................	13,916	2·83
St. Luke's....................	49,982	2·81
Greenwich....................	75,684	2·79
Stepney.....................	90,657	2·75
Mean of fifteen *morbid* districts		3·06 or 1 in 32

Registered Districts.	Population.—1841.	Amount of Mortality per cent.
Strand	43,894	2·73
Clerkenwell..................	56,709	2·69
St. Martin's in the Fields	25,195	2·51
Kensington	114,952	2·45
St. James's, Westminster.......	37,407	2·34
Poplar	31,091	2·33
Lambeth	115,883	2·21
Newington	54,607	2·19
Islington	55,720	2·13
Marylebone..................	137,955	2·11
City of London	55,967	2·07
St. Pancras	129,711	2 04
St. George's, Hanover-square ...	66,433	1·95
Camberwell..................	39,867	1·92
Hackney	42,274	1·83
Mean of fifteen *healthy* districts		2·23 or 1 in 44½

What a sad exhibition of aggravated human suffering and death is presented in this table! The districts of St. George's, Hanover-square, Pancras and Marylebone, in which are the mansions of our aristocracy, capitalists, opulent lawyers and physicians, have a mortality as low as 2·03 per cent., or 1 in 49,—whereas, in Whitechapel, St. Giles's, the Borough, Shoreditch and Bethnal-green quarters, in which are herded the lowest and most wretched of our countrymen, the yearly deaths are nearly doubled, rising as high as 3·26 per cent., or 1 in 30·6,—a difference which must be ascribed not strictly to the density of the population, but to the density of the *effluvial poison* generated in the latter quarters, the neglect of cleanliness, the general indigence of the inhabitants, an insufficiency of proper nutritious food, and an indulgence in drunken debauched habits, almost necessarily flowing out of their total estrangement from domestic comforts. We shall exhibit the principle laid down in a still stronger light, by selecting portions of a sub-district, divided into four nearly equal classes, according to the wealth and comfort of the inhabitants.

Classes of Sub-districts.	Population in Registrar's books 1841.	Calling and Condition.	Mean annual Mortality for 5 years.
1.—Mecklenburgh and Brunswick-sq., Guildford, and Bernard-st., Landsdowne-place....	4,432	Merchants and professional men.—*Wealthy householders*..........	1 in 46·6
2.—Judd, Compton and Leigh-streets	4,465	Tradesmen and lodgers—*respectable*..........	1 in 37·5
3.—Cromer-street, its bye lanes, &c............	4,448	Tradesmen and artizans chiefly in single rooms—*poor*..................	1 in 28·7
4.—Compton-place, Prospect-terrace, Charlotte-street, and Field-street.	4,386	Day-labourers, &c., badly lodged—*extremely indigent*................	1 in 23·2
Total Average........	4,433		1 in 31·9

It may be urged, however, by those who are prejudiced against any reforms whatever, that the miseries perceptible in the lower quarters of the town are the unavoidable consequences of fluctuations in trade, want of employment, loss of character, and precarious means of existence. *Some* of them are so, it is true, but *not all:* and it is our bounden duty to alleviate the miseries of the poor, to remove a portion of their weary burdens, if we cannot relieve them of their entire load. The human system, we are all aware, becomes more susceptible of disease, if not supplied by proper quantities of wholesome aliment;—but add to this the want of good, oxygenated air, and substitute in its place an atmosphere poisoned with animal and vegetable effluvia; then you introduce another and still more deadly agent in the work of destruction:—the latter is *removable,* and on every principle of humanity and state economy ought to be removed forthwith. We have ample documents before us, to prove that the fatality of almost every disease is aggravated by neglect of the means of cleanliness and ventilation; but we shall for the present confine ourselves to fever, on which we propose to cite the Report of Dr. S. Smith, M.D., one of the Sanitary Commissioners. Speaking of Bethnal-green and Whitechapel, he says:—

> "It appears that the streets, courts, alleys, and houses in which fever first breaks out, and in which it becomes most prevalent and fatal, are *invariably* those in the immediate neighbourhood of uncovered sewers, stagnant ditches and ponds, gutters always full of putrefying matter, nightmen's yards, and drains; the soil of which lies openly exposed, and is seldom or never removed. It is not possible for any language to convey an adequate conception of the poisonous condition in which large portions of both these districts always remain, winter and summer, in dry and in rainy seasons, from the masses of putrefying matter which are allowed to accumulate in open ditches, ponds, and dung heaps, with houses all around them. The stench is quite intolerable; and no one who had not seen it would believe that such a thing could be allowed; indeed, no strength of constitution would be able to resist constant exposure to the exhalations always arising from these collections of filth. As respects the houses in Bethnal-green, hardly any part of which is drained, dampness is an evil almost universally complained of by the inhabitants, as well as the wet and muddy condition of the streets during a considerable part of the year. In the less open parts of Bethnal-green, and in a considerable part of Whitechapel, the closeness of the streets, lanes, alleys, and courts is most oppressive; a fresh current of air can hardly ever reach them; and the evil is greatly aggravated by the very general custom of the people (chiefly weavers) permanently to close the windows of their houses, partly for the sake of warmth, and partly to prevent the evils, real or imaginary, of the air on the silk in their work. The preceding facts point to one effectual remedy for lessening the sickness of these and similar districts, namely, the removal of the sources of the febrile poison; and there can be no doubt, that by proper drainage, cleansing, and ventilation, a great deal of these sources of evil to the humbler classes might be altogether removed. The *extra* annual expenses to Bethnal-green and Whitechapel Unions for fever cases *only*, may amount to about 2,500*l.* yearly; and if this money were to be expended in removing the causes that produce fever, there would be a great saving to the parish, and a great benefit to the poor,—it would be a measure at once of humanity and economy."

The character and long services of Dr. Southwood Smith place his testimony above all suspicion of exaggeration; and we appeal to our artizan readers, whether *they* cannot confirm in whole, or in part, the general statement of this able physician. Yes, there can be no doubt, that the stifling atmosphere of dwellings, in which air, once expired in a poisonous state, is again and again inspired in admixture with effluvia still more venomous, must be a prolific cause of disease; and we conjure such of our friends as lend an incredulous ear to these warnings, not to pass with indifference the slow, stealthy, but fatally effective influence that this worst species of malaria must produce on living beings, whose respiratory organs destroy each minute about a gallon of vital air, substituting for it about the same volume of carbonic acid gas,—a fact, from which it is apparent that each individual in full health requires for respiration about sixteen gallons of air per minute.

We leave the Metropolis, not from want, but rather from the over-abundance of materials for illustration, which, however is the less necessary, as the facts themselves are daily in the power of those who by choice or compulsion visit the regions of malaria. Our readers will please to accompany us to Liverpool, a locality of which it was said, seventy years back, that it was "one of the healthiest places in the kingdom, with an air more pure than in the generality of English towns," but which, at present, (as was shown in our last article,) is one of the most unhealthy towns in England, little better than a constant nursery for fever and consumption, owing to the utter inattention of the rapidly increasing population to the simplest measures for insuring health and domestic comforts. In fact, the people in the heart of the town are so crowded together in filthy, unsewered streets, lanes, courts, and cellar-residences, that there is a district comprising about 12,000 inhabitants crammed into an area of about 100,000 square yards, *i. e.* in the ratio of nearly *half-a-million to a square mile*, being about two-and-half times as closely congregated as in the densest part of London. In addition, however, to mere overcrowding, which *per se* is a tremendous evil,—we may mention the vicious construction of the dwellings, for the most part, in close narrow courts and blind alleys, the insufficient supply of out-offices, and receptacles for refuse and excrementitious matter, the absence of drains, the deficient sewerage, and the circumstance that nearly one-tenth of the inhabitants live in dark and generally damp cellars, as abundant concurring causes of the high mortality of Liverpool, the largest and most important of all our great commercial towns. The following table, for the facts of which we are chiefly indebted to Dr. Duncan's pamphlet, "on the Physical Causes of the High Rate of Mortality in Liverpool," exhibits the amount of the general population, and proportion of cellar-residents, persons dying each year, &c., &c., within the parish.

Wards.	Population in 1841.	Square yards to each individual.	Proportion per cent. living in		Propor. per cent. of sewered streets.	Amount of Mortality in three years.	Proportion of fever cases annually in population in five years.
			Courts.	Cellars.			
Vauxhall	26,146	19·50	44·3	12·4	30	1 in 23·5	1 in 27·4
St. Paul's................	18,002	18·76	28·8	11·0	38	1 in 30·7	1 ,, 51·8
Exchange................	17,769	19·44	23·0	14·1	37		1 ,, 26·2
Castle-street	9,691	19·36	18·8	5·9	42		1 ,, 48·
St. Anne's	18,882	24·86	29·6	10·5	36	1 in 31·5	1 ,, 79·
Lime-street...............	18,848	23·51	21·6	4·7	45		1 ,, 182·5
Scotland..................	35,613	46·03	31·3	9·3	35	1 in 31·7	1 ,, 77·
St. Peter's	9,533	25·49	16·7	5·2	46	1 in 31·4	1 ,, 69·1
Pitt-street	15,263	26·81	11·4	13·7	48		1 ,, 64·1
Great George-street........	19,645	24·76	23·4	6·8	49		1 ,, 47·2
Rodney-street	15,202	56·79	16·9	6·0	51	1 in 41·6	1 ,, 235·7
Abercromby	15,899	57·83	13·5	6·2	54		1 ,, 238·7
Totals	220,493	30·70	23·3	8·8	44	1 in 28·8	1 in 95·5

It will hence be observed that Vauxhall-ward, half the population of which live in courts or cellars, is that most visited by fever, and that also in which the mortality rises as high as 4·3 per cent., killing off 1 in 23½ yearly, —whereas, in Rodney-street and Abercromby-wards, where fever least prevails, and the annual deaths are only as 2·4 per cent., only a fifth of the population reside in courts and cellars. The same connexion will be found to subsist between fever, death and cellar-residence, in most of the other districts; but the reader will bear in mind, that the proportion of court and cellar population, is merely *one* element of mortality out of several that are exerting a constant influence, and, besides, the state of the courts or cellars is another very important consideration, filth and closeness being the characters of some much more than others. Dr. Duncan has abundantly shown this, for in Vauxhall and Exchange-wards, where two-thirds of the courts are closed and dirty, the deaths are as high as 1 in 27, whilst in Scotland and Abercromby-wards, remarkable for airy, respectable courts, the mortality is only as 1 in 36, or 2½ per cent. The table shows, also, that fever and death proceed inversely as the efficiency of sewerage, except in Scotland and St. Anne's, where the operation of deficient drainage is counteracted, as it were, by alleviating causes:—there can be no question, therefore, as to the vast importance of an effective system of sewerage carried into the heart of the densely populated localities inhabited by the working classes. The second column, which denotes the *density* of the population in the several wards, furnishes matter for other important conclusions, quite confirming our views of sanitary reform, and the evils that it proposes to remedy. A word on the Irish poor resident here; and then, adieu to Liverpool. These hapless immigrants are especially exposed to the operation of the physical causes from which fever takes its origin. They inhabit the filthiest and worst-ventilated courts and cellars, congregate the most numerously in dirty lodging houses, are the least cleanly in their habits, and the most apathetic about every thing that befalls them:—accordingly, wherever they are found, fever, also, is found committing more than usual ravages. Neither is this indifference to health and comfort a consequence merely of unusual poverty and destitution; but it appears rather to arise out of an innate indifference to filth, a monstrously low standard of comfort, and a sort of gregariousness which leads them, even when not compelled by necessity, into unhealthy localities, rendered still more insalubrious by their recklessness and peculiar habits, which, besides injuring themselves, spread a physical and moral contamination all around them, that is fast extinguishing even among our own poor all sense of moral dignity, self-respect, and independence. We can bear ample testimony, from personal knowledge of the truth of these and similar statements, which are well expressed by Dr. Duncan in his Report on the Health of Liverpool. (Local Sanitary Reports, England; p. 293—4.)

Now to Manchester, which during fifty years has risen from comparative insignificance to its present exalted pre-eminence, as the second town in England, with respect to extent and population, and by far the first industrial town, either in the empire, or the entire world:—and so great are the physical evils affecting the poor here, that it is quite painful to contemplate, in the midst of what appears an opulent, spirited, and flourishing community, such a vast multitude of our poorer fellow-subjects, the instruments by whose hands these riches were created, condemned to dwell in situations where it is almost impracticable for them to preserve health, or decency of deportment, or to keep themselves and their children from moral and physical contamination. Indeed, such is the present degraded home-condition of nine-tenths of the working classes in this gigantic factory-town, (and they form 64 per cent. of the entire population,) that to require them to be clean, sober, cheerful, and contented under such circumstances would be a vain expectation. The cause of these evils may in a great measure be traced to the history of the town; for Manchester, with its eight townships, and 263,000 inhabitants is, after all, a huge, overgrown village, built without any definite plan. The factories have sprung up along the banks of the river, brooks, and canals; and the work-people's dwellings have kept increasing in the neighbourhoods of these factories,—the growth of the town, and the manner of its growth, being thus determined, merely by the interest and convenience of individual manufacturers and owners of property, and not by any regard to the comfort, health, and happiness of the great masses of the community. Till the year 1828, there was not a single paving or sewering act in any of the townships of Manchester; and the consequence of the disgraceful condition of the bye-ways and lanes, on the invasion of the cholera, was perfectly terrific,—the fatality of the cases exceeding that in any part of England, except Liverpool. The Police Act of 1831, it is true, has effected great improvements by compelling the owners and occupiers of property to pave and sewer streets, and within the last twelve years the streets have been paved and sewered, by order of the Police Commissioners, to the extent of about *fifteen miles* in length, thus greatly diminishing the causes of fever, and proportionally raising the general standard health of the inhabitants. Manchester, however, has to the present time no Building Act that affects the great mass of tenements; and hence new cottages with or without cellars are seen springing up, crowded row behind row, badly drained, and in dirty streets, odorous with exhalations from every kind of abomination cast forth from the houses:—with these streets the police have not yet interfered, probably from want of power to compel improvement in by-ways of a certain character; and thus an evil of awful magnitude still remains unremedied. If, in addition to this, we consider that about 15,000, or 12 per cent. of the working population, constantly inhabit cellars, it must be acknowledged that some system of sanitary inspection—some power to compel obedience to instructions on cleaning the streets, and reconstructing the houses of the poor, is imperatively required by the circumstances of the case. It has been already shown that the mortality of Manchester is exceedingly high (3¼ per cent. or 1 in 30·9), and we still conceive that the surplus of deaths (about 1¼ per cent.) is due less to the *factory* than the *town*. The *factories* are spacious, well-ventilated, and rigidly inspected by authority of parliament; the labour, at the same time, is light, and now confined to moderate hours daily:—an examination of the factories will prove the correctness of this statement. What the *homes* of the work-people are will be apparent at once to any who may have wandered through Hanover-street, and Garden-street, in the Collegiate church district—a locality nearly as disgusting as the back streets in our Whitechapel; Pott-street, and Lloyd-street, in the Ancoats-districts; a few of the streets in Angel-meadow (sad misnomer), the whole of Little Ireland in the Bank-top district, and the Oldfield road in Salford. In all these neighbourhoods fever is a pretty constant visitor, but in different degrees, as will be apparent from the proportion of fever to other diseases in one year's practice of the Royal Infirmary. The following statement was drawn up by Dr. B. Howard, and will be found in his Report to the Poor Law Commissioners.

Collegiate church district .	.	25·6 per cent. of fever.
Angel-meadow ,, .	.	21·6 ,,
Bank-top . ,, .	.	15·8 ,,
Ancoats . ,, .	.	14·4 ,,
Deansgate . ,, .	.	13·8 ,,
Salford . ,, .	.	15·3 ,,

Here we see a full establishment of the opinion that human miasms constitute a fertile source of fever; which is, almost without exception, most prevalent and most fatal in the more confined, close, and ill-ventilated parts of the town, and in over-crowded lodging-houses. The Collegiate church and Angel-meadow districts are certainly the worst in this respect; and there, also, the proportion of fever cases is much higher than elsewhere.

The following is a graphic, but by no means over-coloured, picture of Little Ireland, in Angel meadow; and is extracted from the manuscript proceedings of the Special Board of Health at Manchester:—"In the main street, and courts abutting on it, the sewers are all in the most wretched state, and quite inadequate to carry off the surface water, not to mention the slops thrown down by the inhabitants in about 200 houses. The drains are in a most disgusting state, inaccessible from filth, and too few for the accommodation of the people (averaging about 250 to each!) The upper rooms are, almost without exception, very dirty; and the cellars much worse—all damp, and some occasionally overflowed. The cellars comprise two rooms on a floor, each about nine feet square, inhabited by two or more people. In many the inmates have no beds, keeping themselves warm by close stowage, on shavings, straw, &c., and rarely having clothes to change; in addition to which, the back rooms, where they sleep, have no other means of ventilation than from the front. Some of these cellars were once filled up as uninhabitable; but some have been excavated, and are now inhabited, notwithstanding the constant indrain of surface water; which is plentifully increased from a filthy, stinking brook, that flows close behind the street." This wretched district is the chief haunt of the Irish, who are proverbially reckless, disorderly, and depraved; but there are so many others, scarcely a shade better, inhabited solely by English (hand-loom weavers and mill hands,) that the reader may accept the description as a portraiture of the dwellings generally, in which fully one-fifth of the total population live for a while in excessive misery, and meet an early grave. A map of Manchester might be so coloured as to show, with a single colour, the residences of the industrious poor, and the abodes of fever, consumption, and death. In such haunts as these—to which the helpless artizan is forced to resort for want of better—more than half the children born are *killed* by epidemics or convulsions before they have completed the fifth year; the fathers seldom or never attain the age of forty-five; and the surviving widows and orphans are sent to subsist in the better—far better—atmosphere of the prison furnished by the Poor-law Commissioners. Alas! that such miseries—so *easily removable*—should still exist unrelieved!

We subjoin a table of population, births, and deaths for the eight townships:

TOWNSHIPS.	Population, 1841.	Propor. of births ann. to population.	Propor. of deaths ann. to population.	REMARKS.
Broughton	3,793	1 in 36·8	1 in 63·2	Broughton and Pendleton, suburban districts of Salford, are but little inhabited by the working population; and Cheetham and Chorlton have a tolerably large proportion of wealthy inhabitants. Many of the mill-hands and weavers live in Hulme and Ardwick;—but seven-tenths of the operatives live in Manchester and Salford.
Cheetham and Crumpsall	8,825	,, 34·7	,, 53·5	
Pendleton	10,905	,, 25·5	,, 44·9	
Chorlton-on-Medlock....	28,322	,, 26·1	,, 38·5	
Hulme..................	26,819	,, 23·2	,, 37·9	
Ardwick	9,906	,, 24·3	,, 35·8	
Salford................	51,522	,, 22·8	,, 31·4	
Manchester.............	163,667	,, 26·8	,, 28·3	
Total..........	303,759	,, 25·7	,, 30·9	

The extent to which these remarks have already run reminds us that we must defer to another opportunity the details necessary for showing the amount of the existing physical evils that we desire to see remedied; but, meanwhile, we trust that quite enough proof has been adduced to satisfy our readers that sanitary reform is no visionary scheme; but must—and speedily too—be fully realised—in order to save the thousands of useful fellow-beings that are annually falling martyrs to the neglect of proper regulations for the formation and healthful regulation of large towns. Should these observations meet the eye of men of influence and property in such localities, we conjure them, on the principles of humanity and self-regard, conjointly, to leave no exertion unemployed for procuring an amelioration of existing evils; and to the artizans themselves we urge the importance of listening to our statements, however distasteful and unwelcome, as exposures of their miserable condition; which, familiar as it may be to them, is in no degree less dangerous, or less subversive of physical health and moral dignity. To fly from evil at all risks is the first duty; and if this be not possible, no circumstances can absolve them from the duty of mitigating the evils with which they are surrounded by a rigid attention to domestic and personal cleanliness, so far as it is attainable. The legislature must, ere long, interfere to remove these crying evils altogether.

ART. V.—ADMIRALTY VIRTUE.

WE have often heard of the profligacy of governments, but in all such accounts we conceived there must be much exaggeration; for, in these times of reformation and enlightenment, we could not bring ourselves to believe that the grandees of the land could be guilty of the scandalous corruptions so often laid to their charge. A few cases, however, have lately come under our notice, which have well nigh cured us of our incredulity; for they reveal so much jobbing and rapacity, even in the most trivial matters, that we are left at no loss to imagine the height to which such iniquities may arise when the spoil is less inconsiderable. The cases to which we allude are samples merely of the disgraceful system of patronage carried on in the Woolwich dock-yard, and which has now risen to such a pitch, that not even a common workman can be employed unless he has first succeeded in propitiating, by some suasory or other, one of the Lords of the Admiralty. We do not imagine that any of these great personages is open to a bribe of money; but we do imagine that they are open to bribes of other kinds, for which the employments of the public are bartered away. We know that there are certain soft and convenient names by which such a traffic is distinguished; but it is not one whit the less, on that account, a work of the most disgraceful bribery,—and of all kinds of bribery, that which is paid in jobs is the worst. A man who pays in money, pays at least what is his own; whereas, in the other case, the payments are made with what is not his own, but with the employments intrusted to his safe custody by the nation.

Most of our readers are aware that, in the Woolwich dock-yard, there are a number of engineers kept in employment. This staff is presided over by Mr. Lloyd, an engineer of great skill and experience, assisted by several sub-engineers of nearly equal ability: yet we have it on good authority, that by none of these respectable and competent persons can a single workman be taken into employment; and a workman who wishes for employment at Woolwich, must apply to the Lords of the Admiralty. The purpose of this arrangement cannot be pretended to be a regard to the public advantage; for it is not to be supposed that a Lord of the Admiralty, who hardly knows a cylinder from a boiler, can be as good a judge of the eligibility of a workman as a practical engineer, who *is* conversant with such subjects. What, then, can be the purpose of the selection of workmen being made by the Admiralty? Simply and solely that it may have a little more patronage; that "My Lords" may be able to barter away an employment or two for the electioneering support of some workman, or of his father, uncle, or other relative: or, if there be no regular bargain struck, that they may at least fortify their interest by such jobs and pensions as will tell at the right time in the right quarter.

All this it is impossible to deny; and the question arises, are such abuses to be suffered to continue? Messrs. Maudslay and Field, Messrs. Miller and Ravenhill, and, indeed, all engineers of respectability, refrain most scrupulously from engaging men themselves: they leave that task to their foremen, being very well assured that for them to come between the foremen and the men would be subversive of all discipline, and bring the foremen into contempt. And why should not Mr. Lloyd, or rather the foremen under him, be put upon the same footing as the rest of the foremen throughout the kingdom,—and be suffered to perform the tasks which every other foreman is found able to execute, without which efficiency is next to impossible? It is inconceivable to us, indeed, how the Woolwich factory is carried on at all under the present system: it must necessarily be carried on very badly; for, of workmen introduced through mere favour, a great number must be good for nothing; while some, relying on the circumstance of their having friends at court, will give themselves all sort of airs, and, perhaps, make themselves excessively troublesome. All these evils are the natural results of so vicious a system,—a system we may add which is in every way ineligible and indefensible, and must be put down. Abuses of such flagrancy are not to be tolerated in these days of intelligence. The artizans are now becoming the censors of the age; and let our grandees look to it, that they are able to lay their hands to their hearts and justify their procedures; for they will certainly be unable to resist the current by which all such abuses must inevitably be swept away.

ART. VI.—A RECEIPT FOR SAVING FUEL.

WE are not now going to perplex our readers with the details of any particular contrivance for saving fuel, but merely to recommend to those who have fuel to save, the adoption of an expedient which in every case in which it has been tried has been completely successful—we mean registration. In all engines on land there is nothing easier than to keep an account of the work done by an engine, so that it may be compared with the fuel consumed; and in every case in which this has been done, and the results published, a prodigious saving of fuel has been the consequence. In Cornwall, by the mere introduction of the plan of registration, the economy of fuel has been increased four-fold; it brings every improvement in its train, and excites among firemen and engineers an extraordinary emulation to out-do one another. In the manufacturing districts—in Manchester, for example, in Leeds, and all the other large towns where a multitude of steam-engines are employed, a vast economy would be realised by the use of this most simple of expedients, and we verily believe that the smoke nuisance would also be thereby greatly abated, without the introduction of any specific scheme for that purpose. A doubt has arisen, we believe, whether the Cornish plan of working engines on the expansion system is applicable with advantage to the purposes of manufactories. We have no doubt ourselves on the subject, provided only that the engine be suffered to run a little quicker, and be provided by a more powerful fly-wheel. This, however, is a question which should not be agitated in connexion with the plan of registration; for whether all or any of the Cornish contrivances are or are not applicable to factory engines, the advantages of registration are still as eminent, and will bring the engines of factories to as rapid perfection as those engines have been brought to which are employed for pumping water. We should suggest, then, that the owners of engines in every great manufacturing town or district appoint an inspector to take an account of the work done by the said engines, to which end every engine should, of course, be provided with a counter; and if the returns be forwarded monthly to us, we will publish them; so that every engine-proprietor may be enabled to compare his expenses with those of his neighbour, and that the economy realized in particular towns or districts may be compared together.

Art. VII.—THE MARINE GLUE.

This appears to us one of the most valuable inventions of the day, and not one of the least extraordinary. We could easily have conceived the practicability of making a composition possessed of some of the qualities by which the glue is distinguished: there are substances familiar to us which would give the same adhesiveness, perhaps, and the same flexibility, but then they become softened by heat, and the substances again which resist heat are soluble in water. We have no doubt that Indian rubber is one of the chief ingredients of the glue, but Indian rubber alone would never answer, and the other substances with which it is compounded appear to completely remove the defects which would attach to Indian rubber singly.

It is needless to enter here into the details of the experiments by which the marine glue has been tested. Those experiments, however, have been most severe and conclusive. Pieces of wood joined by the glue have been subjected to adverse strains, and precipitated from a great height upon a granite pavement. They have also been exposed to shot and shells, and subjected to every conceivable *experimentum crucis*, and in every case in which the joining has been properly made, the wood has given way before the glue. In the cases of violent concussion, the wood has been shattered in every direction, while the glue remained comparatively unaffected. These experiments have been publicly made at the dockyards of Woolwich and Chatham; so that they are completely authenticated.

For joining together pieces of timber for large masts, the glue appears to be particularly valuable, as by virtue of its elasticity it opposes no impediment to the yielding of the mast, when a strain comes upon it. For keeping decks tight, again, it is of much value, as it is not disturbed by the working of the ship. It is also an excellent substance for filling up the cracks and flaws in timber, as by cementing the sides of the crack together, it renders it of no importance. These, however, are trivial uses. We are thoroughly convinced that ships will, before long, be put together by the marine glue entirely. And in the case of dock gates, breakwaters, and numberless other structures, it will also be extensively used. This is all we can now afford to say respecting this excellent compound: those who are desirous of learning more, we refer to a pamphlet entitled "Notes on the Marine Glue," by Alfred Jeffrey, patentee, a production of much literary merit, and singular modesty.

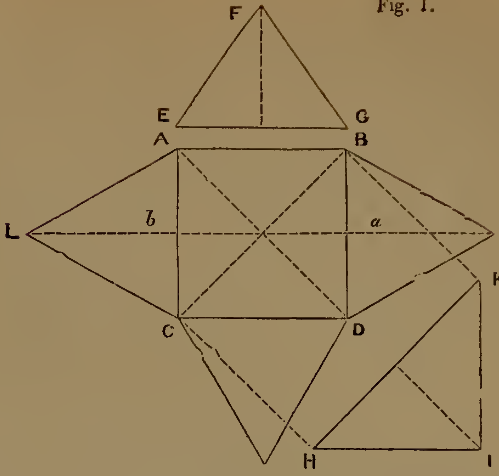
Art. VIII.—THE BUILDING ARTS.

GEOMETRY OF THE CONSTRUCTIVE DETAILS.

Science, as applied to the art of building, has reference, not merely to the construction of buildings with the requisite stability, but to their construction at the minimum expense of labour and materials. The importance of such a branch of knowledge is sufficiently obvious, not merely in the case of the engineer or architect, by whom buildings are designed, but in the case of the builder by whom they are erected. To build scientifically, indeed, is to build well, and the workman who aspires to a thorough knowledge of his business must resolve to make himself master of its scientific principles. This we promise to enable him to do, if he only consents to give a moderate degree of attention to our expositions. Nor is any long or painful study on his part needed, for the scientific elements with which we shall have to deal are neither difficult nor numerous. We are, therefore, able to promise with much confidence, that every workman who reads the Artizan with common attention, will in a very short time become a complete master of the art of building. The scientific knowledge, which is chiefly required in laying down working drawings, is that species of practical geometry which relates to the sections of solids, the developement of their surfaces, and the sectional delineation of their solid angles. Of these solids, the pyramid, the cylinder, the sphere, and the cone are the chief, and it is to the sections of these simple forms our attention will be mainly directed.

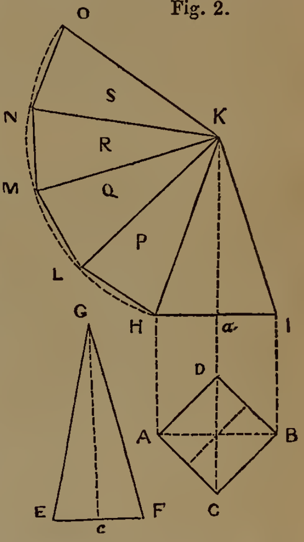
The sections of the pyramid, and the developement of its surfaces, may be applied to the theory of all intersecting plane surfaces and their solid angles. Its base is a plane or flat surface of any regular figure; its sides are triangles, all terminating at the top in one common point or vertex. The figure of the hipped surfaces of the roof of a house, whose plan is square, may be said to belong to this class of solids. Let A B C D, fig. 1, be the plan of the walls, the triangle E F G, the right section through the roof on the line *a b*. The triangle H I K, shows the section of the roof on the line C B, the perpendicular height of both triangles being equal. The developement of the slanting surfaces of the sides will be obtained, by making the lines A L, C L, respectively equal to the sides H I, I K, of the triangle H I K.

Fig. 1.



Another mode of laying down the developement of pyramidal surfaces, is shown by fig. 2. Let the surface, A C B D represent the base of the pyramid; E F G its section on the line *a b*; in the triangle H I K make the perpendicular height K *d* equal to the line G *c* of its right section; and the base line H I equal to the diagonal line A B; the triangle thus formed will be the section of the pyramid on the line A B: take the length K H, and with K as a centre, describe the circle H O, make the lines H L, L M, M N, and N O equal to the sides of the base A C, or C B, draw the lines K L, K M, K N, and K O, and the triangles P Q R and S, are the developed surfaces of the sides of the pyramid.

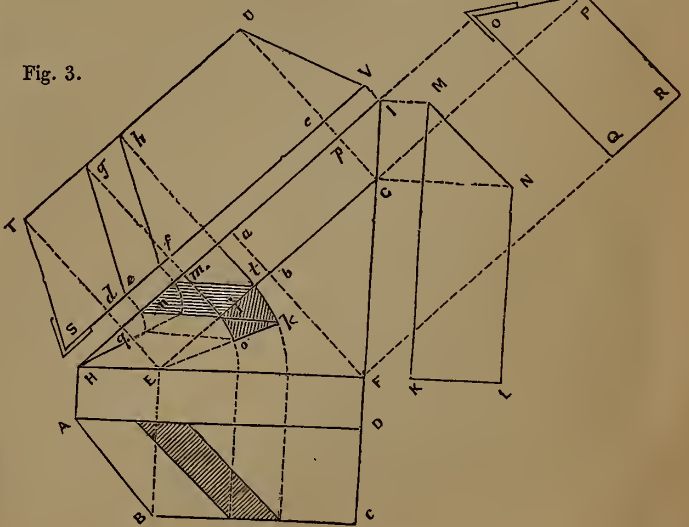
Fig. 2.



The sectional angles of pyramidal solids are of great use in ascertaining the proper bevels of the beds, and faces in oblique arches whose coursing joints are plane surfaces. They are also applicable to various other details, such as the mode of finding the bevels for the application of the moulds, for cutting out the wreathed portions of hand-railing, &c.

That the student may see the utility of these sections, let us suppose the lines A B C D, fig. 3, to represent the base of a portion of a pyramidal

Fig. 3.



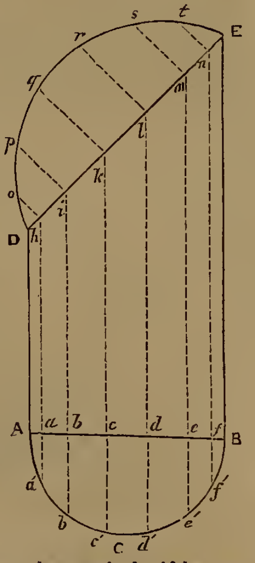
solid, whose triangular sides are parallel, and at right angles or square to the base. Let the triangle E F G, represent the elevation of the side on the line of its base B C, and H I F, the triangular surface of its opposite side, then the surface of its slanting face, will be represented in a projected view by the figure H I G E H. Let D C be the distance between its parallel sides; make K L equal to D C, draw the lines K M and L N, make the height K M equal to F I, and L N equal F G, join M N, and the figure K L M N will be the elevation of the side of the solid upon the line D C of its base. To find the cutting section of this solid through the points *a b* F, draw the line F Q R; make Q R equal to the thickness of the solid, as shown by the line K L, or D C. Draw the lines Q O and P R perpendicular to Q R; make R P equal to F *b*, and Q O equal F *a*; join O P, and the line O P will be equal to the width of the upper slanting surface of the solid. The lines O P Q R will be the boundary of the section of the portion of the pyramid through the points *a b* F. The developement of the upper slanting surface is shown by the lines S V U T. Let the line S V represent the arris H I of the solid, make V *c* equal I *p*, and S *d* equal H *q*, draw the lines *d* T and *c* U perpendicular to the line S V. Make T *d* and V *c* respectively equal to the line O P of the surface of the right section. Join T V, T S, and V U; the lines S T, T U, U V, and V S are the boundaries of the upper surface. Again, let us suppose the shape of this solid to occupy the position of a portion of a wall through which a semi-circular arch is to pass obliquely in the direction shown by the oblique line A B, let the figure shown by the lines *i o l k*, represent the face mould of one of the arch stones on the face of the wall; *n i m l* will represent the position of its upper bed; the line H E will represent the axis of the cylinder, and *n i* the arris of the intrado of the stone. Then, as the intradosial arris *n i*, is parallel to the line of the axis H E, its corresponding line *c q* on the developement of the upper surface (of which the bed of the stone forms a portion,) will also be parallel to the intersecting line T S, which is common to both the upper surface and the base of the solid. The bevels therefore of the arrises of the bed of the stone will be equal to the angles T S *d*, and S T *g* of the slanting surface of the pyramid, and the bevel of the face of the arch, with the bed of the stone, will be of the same angles as Q O P, and O P R, on the cutting sectional line *a b* F of the solid.

Cylindric solids and their Sections.—To the sections of cylindric solids and their developed surfaces, belong that description of work relating to plain, oblique, and spiral arches, centring for arched groins and their solids, cradling to cove ceilings, staircases, hand-rails, &c., &c.

The cylinder in geometry is, as every one knows, a solid, whose ends or bases are circles;—the sides being formed by a rectangular figure revolving upon one of its ends. The developement, or surface of a cylinder is manifestly a parallelogram, whose length is equal to the height of the cylinder, and its width equal to the length of the line of its circumference.

By the section of a cylinder, is meant the surface of a plane, formed by the cylinder being cut through. The oblique section of a cylinder is an ellipse, whose minor axis is equal to the diameter of its circular base, its major axis equal to the extreme length of the cutting line of the section. For practical purposes, the mode of forming the elliptic curve of the section is by means of a tramel. The description of this instrument, and its application, we shall give in a future Number.

Fig. 4.



Let A B C, fig. 4, represent the base of a cylinder, A D B E a portion of the surface through its axis D E, the cutting line of the section. Divide the line of its circumference A C B, into any number of equal parts A *a*' *b*' *c*' *d*' *e*' *f*' B, from the points *a b c d e* and *f*, let fall the perpendiculars A' *a*, *b b*', *c c*', &c., cutting the line A B, in the points *a b c*, and let the perpendicular lines thus drawn be produced, until they meet the cutting line of the section D E, in the points of *h i k l m n*. Draw the lines *h o*, *i p*, *k q*, *l r*, *m s* & *n t*, perpendicular to the line D E; make *h o*, *i p*, *k q*, *l r*, *m s*, and *n t* respectively, equal to the ordinates *a a*', *b b*', *c c*', &c.; through the points D *o p q r s t* E draw the curve line; which is the section required. In the common arch, which we shall here, for distinction sake, designate as the cylindric arch, the whole of the ring may be conceived to consist of the united portions of a series of wedge-formed solids. The planes of their radiating surfaces are at right angles with the face of the vertical face of the arch, their surfaces intersecting each other in, and passing through the axis of the cylinder of which they compose a part. The intradosial surfaces of the ring stones are parallelograms, whose united widths constitute the developement of the surface of the cylinder.

A plain oblique arch is similar in all respects to the common arch, excepting that the vertical plane forming the face of the arch, forms an oblique angle with the face of its abutments E G and D F, or the pier on which it rests. Thus, in an oblique arch, whose right section is that of a cylinder A B C, in fig. 5, the face of the arch will be formed by the elliptic surface of its cutting section D F E. The developement of its soffit would be bounded by curvilinear lines, as shown in fig. 5. The mode of obtaining the moulds, for the construction of the ring stones, is in the manner already intimated in the description and use of the pyramidal solids, which we shall enter into more fully hereafter.

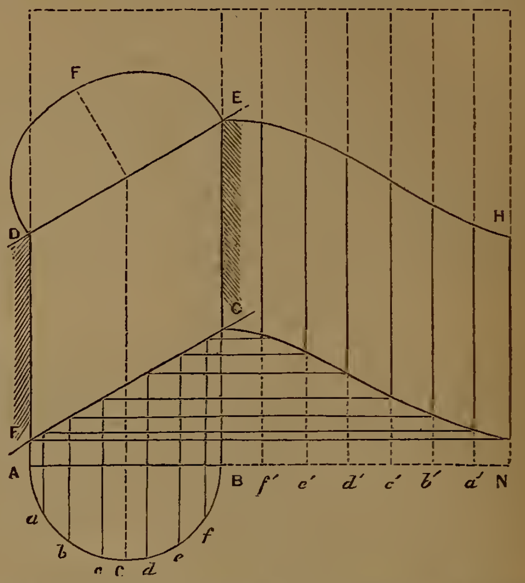


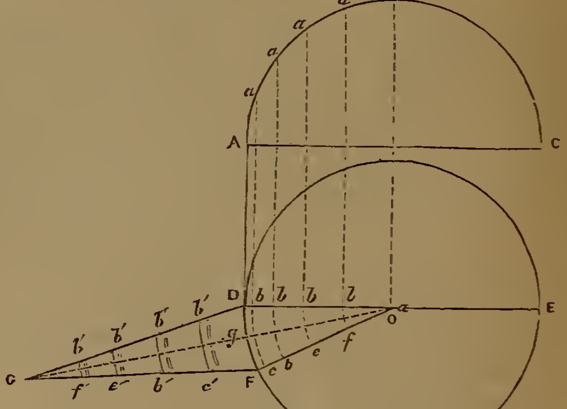
Fig. 5.

Spherical Solids and their Sections.—To this class of solids belongs that branch of geometry usually applied to the construction of domes, pendantives, cradling for niches, spherical roofs, &c. The form and disposition of the parts composing the dome may be conceived by supposing the surface of the hollow globe to be divided into a certain number of parts, in a way similar to that adopted in the formation of the meridian and longitudinal lines of the hemisphere, and the pole may be taken to represent the vertex or summit of the dome. The meridian lines serve to represent the position of the rafters in carpentry, or the heading joints of the coursing stones in masonry—the longitudinal lines standing for the purlins in the former, and the position of the coursing joints in the latter.

The developement of a spherical surface can only be effected by approximation. The mode generally adopted is by assuming that the perimeter of its horizontal section consists of a number of polygonal sides of a solid whose surfaces terminate in one common point, in the vertex of each of its opposite hemispheres.

Let A B C, fig. 6, represent the vertical section of a hemisphere, and the circle D F E be the plan of its base. Let the line D E be parallel to the line A C. Divide the circle A B into any number of equal parts, *a, a, a,* &c.; let fall the perpendiculars *ab, ab, ab,* &c., cutting the line D E in the points *b b b*, &c.

Fig. 6.

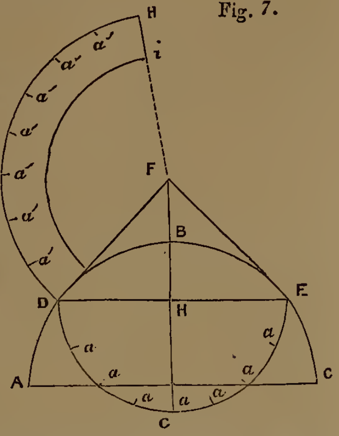


Let D F represent one of the polygonal sides of the base: join F O, and, with the point O as a centre, describe the arcs *b c*, *b d*, *b e*, &c. Bisect D F in *g*: through *g* draw the line O G, and make the length of the line *g* G and its divisions equal to those of the curved sectional line of the sphere A B:

make *b'c'*, *b'd'*, *b'e'*, *b'f'*, respectively, equal to the lines *b c*, *b d*, *b e*, &c., as shown; and through the points *b'b'*, &c., and *f'e'd'*, &c., draw the curve lines G F, G D. These lines form the outline of the developement of the covering of one division of the sphere, as shown.

Another mode of laying down the coverings of the sphere is, by supposing its surface to consist of sundry portions of the surfaces of cones whose slanting surfaces approximate as near as possible to the inclined surface of that part of the hemisphere for which it is substituted.

Fig. 7.



Let A B C, fig. 7, represent the section of the hemisphere. The line D c of the spherical surface is here made to represent a portion of the slanting side of a cone whose perpendicular height is equal to F H; the length of its slanting side equal to D F; and the diameter of its base equal to D E. The developement of the covering is shown by the lines D H, *c i;* the length of the arc D H, with its divisions *a'a'a'*, &c., being respectively equal to the length of the arc D G E, with its divisions *a a*, *a a*, &c. This mode of covering will be described more fully in our treatise of the cone, and its application in the building arts.

In the masonry of a spherical arch or dome the stones everywhere converge towards the centre of the sphere. Each tier of stones constitutes a portion of a cone; the surface of the coursing beds consisting of the developed surface, whether convex or concave, of the portion of the cone thereto appertaining. On this subject, however, it will be time enough to enlarge when we come to the details of the masonry of domes.

In the carpentry of a dome the skeleton frame-work consists of isolated ribs or rafters whose vertical outlines would represent the sections of the convex and concave surfaces of the shell of which the hollow globe is composed. These rafters are stayed by purlins placed horizontally in a direction everywhere at an equal distance from the base of the hemisphere; of which see a more detailed description in Plate XXV., Cradling for Domes.

Before entering, however, into details of construction, it may be well to determine the design for the interior decoration of the concave surface of the dome. The exterior surface is generally finished with deal boarding, upon which a covering of lead is laid. The skeleton frame-work upon which the finishings are fixed is subservient only to the accomplishment of the design.

In the engraving, the design of the interior decoration consists of a series of compartments which are arranged in three tiers of pannels, the pannels and their frames diminishing towards the summit of the dome. In the centre an opening is formed for the admission of light; and such openings are generally furnished with a lantern-sash, having its sides vertical to a certain height, and finishing at the top with a conical sash terminating in a cylindrical block, from which a chandelier is usually suspended. The pannels of the dome are formed as nearly square as the nature of the concave surface of the compartment will admit. The architect, in forming his design, should take into account the foreshortening of the facias in the framing, and the mouldings in the lower extremities of the pannels, consequent on the manner in which they meet the eye of the spectator. This is important, as, in the sinkings of the facias and mouldings of the lower edges of the pannels, if the points of sight are considerably from below, the mouldings will be partially concealed, and the horizontal facias appear out of proportion.

The mode of dividing the concave Surface into Pannels.—Having determined upon the number of the tiers of panels into which the vertical section of the concave surface is to be divided, next proceed to lay down a developement of the concave surface, or of such a portion of it as the architect may consider necessary for one compartment of pannels only, according to the nature of their proportions. Upon this assumed division or outline sketch out the size of the pannels for one compartment only. This being done, proceed to try how far the proportion of the compartment thus assumed will, by being repeated, agree in filling up the whole concave surface of the dome. Should the approximate space assumed for one compartment only be found either too large or too small to constitute an aliquot part of the whole surface, an increase or diminution must be made in the original sketch, so that the total number of compartments may be of such dimensions as may approach nearest the architect's assumed proportions of the compartment first sketched out.

Fig. 3, Plate XXV., shows the developement of one of these compartments taken upon the curved rib, as shown by the dotted line A B in fig. 2. The length of this line is carefully ascertained by dividing the whole distance from A' to B' into any number of equal parts. In the present case we have divided the whole into parts, numbered from 1 to 8. From each of these points draw the plumb-lines A *a*, 1 *b*, 2 c, 3 *d*, 4 *e*, 5 *f*, 6 *g*, 7 *h*, and 8 *i*, cutting the seat of the curved rib in the points *a b c d e f g h i* upon the plan, fig. 1. Then, with the point O as a centre, describe the circular dotted lines *a k*, *b l*, *c m*, *d n*, *e o*, *f p*, *g q*, *h r*, *i s*.—In fig. 3 make the length of the line A' B' equal to the length of the curved rib, as shown by the line A B in fig. 2, with its corresponding number of equal parts from 1 to 8. Through these points draw at right angles the lines *a k*, *b l*, *c m*, &c.; make their lengths respectively equal to the lines *a k*, *b l*, *c m*, &c., in fig. 1. Through the points *a*, *b*, *c*, &c., draw the curved line *a i*, and through the points *k*, *l*, *m*, *n*, *o*, &c., draw the curved line *k* and *s*, which forms the boundary of the compartment. In the design shown by the engraving there are sixteen compartments, of three pannels each, which occupy the whole of the concave surface.

The mode of constructing the Timber Frame-work.—A A represents the purlins which are morticed into the ribs, their ends bolted to each other and to the ribs B B.

B B, the ribs or rafters, formed in thicknesses upon the principle of the arch. The butt-joints radiating towards the centre, each thickness alternately breaking joint with each other. The upper and lower ends of the rib arc in one thickness, on which the tenon is formed. The joinings with the upper and lower plates, and the mode of forming the ribs, is more particularly shown in the elevation, fig. 4.

C C represents the small ribs for the support of the sunk faces of the pannels.

D, the principal curb-plate formed in thicknesses, the butt-joints being tongued. These thicknesses are bolted to each other, as shown.

E represents a curb for the support of the lantern-light; it is formed in three thicknesses, with tongued joints.

F represents the crown-plate of the framing into which the ribs are morticed and bolted.

The mode of forming the Purlins in a Dome Roof.—Let A' B' C', fig. 5, represent the plan of the roof; A B C its section, in which the position of the purlins are placed. The sectional lines of the figure *a b c d* represent the substance of the timber required for the squaring of the purlin; the shaded parts representing the superfluity required to be cut off. The radii of the purlins are shown by the lines *g q*, *h p*, and *k o*, *m n*.

The purlins of the dome, as shown in fig. 4, are formed after this manner according to their respective diameters, and are joined to the ribs by mortice and tenon, and bolted also, as shown.

Wherever two cylindric arches meet each other, or where a cylindric arch is made to intersect with an arch consisting of the segmental portion of any other arch, the intersection of both their surfaces is called a groin; and the quoins of the mitre formed thereby are made to consist of the united portions of the wedge-formed solids which constitute the component parts of both the arches.

Plate XXVI. shows the mode of laying down the moulds, for the formation of the quoins of the masonry, in a groin formed by the intersection of a cylindric arch, with the segmental portion of a spherical arch.

The chord line of the spherical arch, or the diameter of its springing line, and the versed sine or the height of the crown of the intrados, being determined, the length of the radius for describing the curve of the arch, is next wanted. This may be obtained *by dividing the sum of the squares of the half chord and versed sine by twice the versed sine. The quotient is the length of the radius required.*

Example.—Let us suppose the diameter of the springing line shown in the engraving, to be 18 feet, and the height of the arch 2 ft. 6in. above the level of the springing line; then $\frac{9^2 + 2{\cdot}5^2}{5} = 17{\cdot}45$ feet, = the radius for the curve of the arch.

Having described the curve of the intrados of the spherical arch, divide it into the number of arch stones required, as shown by the points *a*, *a*, *a*, &c. Next proceed to lay down the curve of the intrados of the cylindric arch in the position shown. Draw the intradosial arras lines *a a'*, *a a'*, &c., parallel to the level of the springing line, cutting the curve of the cylindric arch in the points *a' a'*, &c.; and from the points *a*, *a*, *a*, &c., in the curve of the spherical arch, draw the perpendicular lines *a c*, *a c*, &c., cutting the diameter of the spherical arch in the points *c c c*, &c.: then with the point O as a centre, describe the circular lines *c b*, *c b*, &c.; and from the points *a' a' a'*, &c., in the cylindric arch, draw the perpendicular lines *a'b*, *a'b*, &c., cutting the circular lines *c b*, *c b*, &c., in the points *b*, *b*, *b*, &c., through which draw the curve lines F O. These form the mitre lines of the groin projected upon a horizontal plane passing through the springing line of the arch.

To find the plan-moulds for any of the quoins, say that of No. 4, let *a'*, *k*, *a'*, *i*, form the section of one of the stones in the cylindric arch; and *a*, *l*, *a*, *o*, form the section of its corresponding course in the spherical arch. Let *d b* and *b g* represent the length of the quoin on the intrados of the groin; draw the perpendicular line *l n*, and the circular line *n h*; let the line *i h* intersect the circular line *n h* in the point *h*, and draw *d e* at right angles to *d b*; *g f* radiating towards the centre O. The figure *d e h f g b d* is the outline of the plan-mould, or size of the stone required for the quoin No. 4. The moulds *a a i k* and *a a l o*, with their circumscribing squares *r s t u* and *p q v w*, show the angle of inclination at which the moulds are applied on the ends of the block of stone, which is previously worked to the plan-mould *d e h f g b d*. The mode of laying down the working drawings for the coursing-stones of the remaining portion of the spherical arch will be illustrated in our treatise on the masonry of domes—which we shall give in a future Number.

ART. IX.—REMARKS ON CUTTINGS, EMBANKMENTS, AND OTHER EARTHWORKS.

On laying out Lines of Earthwork.

Through the New Red Sandstone. — The position of cities, the sites of manufacturing industry, and the main geographical features of a country, must necessarily prescribe within comparatively narrow limits the direction of every newly projected line of communication, whether a road, canal, or a railway. Hence, it is seldom possible, between two given termini, to trace out two distinct lines, each of which shall intersect a different series of geological formations. At the same time it often happens, that a judicious deviation to one side or another might carry the line into far more favourable strata, without entailing any corresponding disadvantages.

The new red sandstone formation has been peculiarly marked out by nature as the theatre of the earliest great earthworks in this country. The Trent, the Mersey, and the Severn, three of the largest rivers in England, with many others of less note, hold the greater part of their course through the rich plains of this formation. The pastures of the new red sandstone are highly celebrated in an agricultural point of view, and taken as a whole, the range of the formation is probably superior to any other in the kingdom for the growth of wheat and barley, as well as beans, peas, and other leguminous plants. Its marls and clays are in many places associated with valuable strata of building stone, also with gypsum and salt, articles of paramount importance in commerce, agriculture, and many other useful arts. Numerous coal fields emerge from beneath the strata of the new red sandstone, forming isolated spots of great importance, scattered over the tract which it occupies. Add to these natural advantages, the broadness and openness of its plains and valleys, the inconsiderable height of its table lands and elevated ranges, and we can scarcely conceive a district more calculated to concentrate within its limits a vast amount of flourishing population, and to command extensive and varied manufactures.

The new red sandstone occupies a great part of the counties of Lancaster, Chester, Salop, Stafford, Worcester, Warwick, and Nottingham; a long dell extends through the East and North-Ridings of Yorkshire; it forms the vale of the Eden in Cumberland and Westmoreland, and the valley of the Exe in Devon and Somerset.

If we consider the richness of the land itself, the commercial importance of many isolated tracts which the formation includes, and the favourable configuration of its surface with respect to levels, we shall be at no loss to account for the fact, that the earliest canals of Britain were traced through the valleys of this class of strata. Amongst these are the Sankey brook canal, the Bridgewater canal, the Trent and Mersey, or Grand Trunk canal, the Staffordshire and Worcestershire, the Birmingham and Fazeley, the Birmingham and Warwick, the Ellesmere, and many others. All these works are laid out entirely in the new red sandstone, and their cuttings and embankments being entirely composed of its strata, it will readily be seen how important to the engineer is the study of this great formation, in connection with the subject of earthwork. In using the term, the earliest canals of Britain, we exclude, of course, the Caerdike, and other works of the Romans in the eastern part of the island. These Roman canals, which were cut principally through the diluvial tracts of the fen country, were more properly works of drainage and defence than of commerce, and therefore belong to another order of events, and another era of commercial history than that with which the engineer of the present day is concerned.

The canals first spoken of were projected and executed by those bold and talented individuals to whom the praise is due of introducing canals into this country, in the latter half of the eighteenth century. Amongst the most prominent benefactors of their country, as the leaders in promoting her inland navigation, may be ranked Francis Duke of Bridgewater; the Earl Gower, his brother-in-law; Mr. Hardman, of Liverpool; and Mr. Wedgwood, the father of English pottery.

The whole extent of the new red sandstone is watered by innumerable streams, which flow in a most circuitous course over every part of its surface. Although, to a superficial observer, it might appear that the hydrographical system of this formation is extremely irregular, owing to the constant changes in the direction of its streams and rivers, it will be found on a closer examination that no such irregularity or confusion exists. The hydrographical aspect of the new red sandstone owes its peculiarity to the general flatness of its surface, and to the elevation of a few central plains, which are obviously connected with the insulated coal-fields of the formation. These central plains are the axes or ridges which throw off systems of streams on each side of their summit line, and may be viewed as the prolongations of those important masses of the older rocks which appear in so many isolated groups in the middle of the new red sandstone district.

Thus, the elevation of the Cheshire plain, which throws off tributaries to the Dee, the Weaver, the Severn, and the Trent, and may be traced from the Mersey across Delamere Forest, and the Pickfaton hills, away into Flintshire and Shropshire, is connected with the protrusion of the South Lancashire coal-field, forming a prolongation to the south of that elevated district. A similar prolongation of the coal district north of Newcastle-under-Lyne throws off tributaries to the Severn, the Avon, and the Trent; and a still more extensive elevation connected with the Dudley coal-field, gives rise to several other tributaries of the same rivers. This general abundance of streams, together with the favourable levels of the whole district, admirably fitted the new red sandstone for the construction of canals over every part of its surface, and accordingly we find it plentifully intersected by inland navigations in those various directions which have been dictated by the commercial relations of the country.

A great variety of strata are included in the formation called the new red sandstone. They may principally be classed, however, into clays, marls, sands, and sandstones. The beds of rock salt and gypsum which occur in this formation will not engage any of our attention at present; because being principally found in the valleys, they seldom enter into the excavations of engineering earthwork. The clays are commonly either red, brown, or variegated,—the reddish varieties decidedly predominating; but although this prominent colour has furnished the name for the whole formation, it would be very rash for an observer to conclude, in every district where there was no redness in the strata, that these could not possibly belong to the new red sandstone. All that must be understood by the adjective here is that red clays, sands, and sandstones prevail more extensively than those of any other colour. The clays and marls of this formation are not more various in their colour than in their hardness and tenacity. Some are so soft as to be readily dug with the grafting tool, so that they can be filled without falling, or being picked to pieces; others again are so highly indurated that they must be undermined, chambered, and brought down in masses, which must afterwards be subdivided by piles and pickaxes before they can be filled. Generally speaking, these clays are not so soluble, or so easily reduced to a paste by water, as those of the London clay formation. Hence, they are not so difficult to deal with in the way of drainage, and their slopes can be made to stand with less difficulty than those of the London clay. It is not accurately known to what the difference is owing, whether to the greater mixture of one or other of these clays with silicious and calcareous earth. We know that those clays which contain a large proportion of silex will readily fall to pieces in water, this being remarkably the case with fuller's earth, which contains 53 per cent. of silex. We also know that calcareous marls, and indeed argillaceous marls, which contain a large proportion of lime, will fall to pieces in water with equal facility. It may be inferred from these facts, that the most impure clays are those which are most readily acted upon by water.

On the Slopes of Cuttings, and the means of preventing Slips.

A great many different expedients have been adopted, with a view of preventing slips; a great deal of conflicting evidence has been given by engineers before Parliament on this subject; numerous accidents, in consequence of slips, have generally aroused the public attention, and served as useful and instructive examples to the engineer; and yet the whole question of prevention remains in as unsatisfactory and imperfect a state as can well be imagined. Drainage, says one, is the great thing to be attended to; and, while few are disposed to question this, all are ready to ask, What kind of drainage is here meant? How is the drainage to be effected? What kind of drains are to be used, how constructed, and of what extent? Give plenty of slope, says another: cut back the ground till you make it almost flat, and you will avoid all danger of slips. This last proposition is absurd, and is not only incapable of general application, but will scarcely suit any one particular case. To increase the flatness of a slope, is obviously to expose a greater surface to atmospheric influences; and this, in such a material as chalk, for example, is decidedly injurious to the stability of a slope. Even in clay cuttings there is nothing like certainty that a slope will stand, however flat it may be. When a natural cliff of clay once begins to fall, owing to the pressure of water behind it, the sandy parts will continue to run out, and bring down successive falls of earth, till the profile will present an extremely irregular figure, with a flatter slope than any which we ever construct in works of art. The process of slipping in many clay cuttings is precisely the same on a smaller scale. Highgate-hill, originally cut at each side of the archway with a slope of about 2½ to 1, presents at this day slopes of 6 or 7 to 1, owing to the incessant slipping of the very treacherous clay through which the cutting is made. Great natural examples of the angle to which cliffs of clay will be reduced by the action of water pressing upon them from behind, may be seen along the south coast of this country, between Hastings and the South Foreland. It is consistent with the experience of all who have had extensive opportunities of making observations on this subject, to pronounce that the flatness of a slope cannot be depended on as a security against its slipping; and, as already observed, there are even some strata which are better with a steep than with a flat slope. We shall proceed to make a few observations upon the slopes of cuttings through those strata which are commonly met with in large earthworks. Without affecting too minute a classification of these strata, it may be sufficient for our present purpose to treat separately upon the well-marked divisions of clays, sands, chalk, and rock cutting. It is true that cuttings are often presented which cannot be directly referred to any one of these general heads; but in this case it will probably be composed of a mixture of two or more; and, as such, may be treated by a combination of the expedients which will be described, for the separate varieties which have been mentioned.

Clay Cuttings.

The geological descriptions for the different kinds of clay furnish the best classification which can be adopted: we shall therefore proceed in this order, with particulars of each, as displayed in actual cuttings, where they have been exposed. First in order, as the uppermost term of the geological series, are the alluvial clays composing tracts of land, which are being formed by causes now in operation—such are the deltas, and the shores of some rivers, the plains covered over by inundations of water, and the deposits left in the beds of rivers, and upon lands which they occasionally overflow. All these causes give rise to alluvial clays, which are commonly soft, and easy to be dug, more or less plastic, sometimes tolerably pure, and sometimes very much mixed with sand and other foreign substances. From the peculiar position of alluvial clays, forming, as they commonly do, tracts of ground on low levels, it seldom happens that deep or extensive cuttings pass through them. In carrying a line of alternate cutting and embankment across a country, to reduce its undulations into the best practicable levels or inclinations, the alluvial clays are commonly embanked over, and have seldom to be cut out, except in the long reaches of some canals, and for the purpose of founding bridges, locks, culverts, &c. Where a permanent slope is to be given to this kind of clay, 1½ to 1 will commonly be found sufficient for a depth of cutting not exceeding 16 or 18 feet, which is the maximum we have seen.

Diluvial clays are those which are extensively spread over the surface of many stratified deposits, and are distinguished from the alluvial in this, that their accumulation is not due to the operation of existing causes, and can only be referred to those which have long since ceased to operate. Diluvial strata are commonly supposed, in fact, to have been accumulated at the time of the Mosaic deluge, and to have been caused either by that convulsion, or by some other of equal antiquity and extent. The clays which are distinguished by the term alluvial, are found in many parts of this country, not only in valleys but on the summits of hills. For instance, a great part of the London clay basin, throughout Essex and Middlesex, is covered over by a thick diluvial deposit: the same thing is met with in the Wealden district of Kent and Sussex. The new red sandstone formation is buried in many places by diluvium, which occurs in vast quantities all through the valleys of the Trent, the Mersey, and other rivers flowing through the red sandstone district. The chalk gravel, so commonly met with around London, from within the limits of the circumscribing belt of chalk, is referred to diluvial action; and the whole fen country of Lincoln, Huntingdon, and the neighbouring counties, is classed, in point of age, with the more limited diluvial deposits in the valleys of rivers. The diluvial clays have many different shades of colour, as yellow, blue, black, and reddish; many varieties of hardness and composition, some being very plastic, some very pure, and others very much the opposite of these, and very full of sand, or mixed with gravel in such large proportions as no longer to rank with the clays properly so called. All the experience derived from earthworks executed in the diluvial clays appears to justify the conclusion, that no material which comes within the operations of the engineer is less to be depended on, or requires more care and judgment with reference to its slopes and the method of forming and preserving them. Probably there is no stratification which enjoys a worse name amongst engineers than that of the London clay formation; yet, bad as this latter is, we suspect that it is a safer material than the impure and heterogeneous diluvial clays which rest upon it. The diluvial covering is, in fact, often confounded with the true London clay of geologists; and it is therefore not suprising that failures and accidents which have occurred in the former have been ascribed to the true London clay, which has consequently acquired even a worse character than it really deserves. The diluvial clay in the neighbourhood of London is commonly either of a yellowish or blackish colour; the former predominating in the higher levels, and the latter in low situations, as in the localities of Westminster, Lambeth, Kennington, &c. The yellow diluvium, again, is very prevalent all round the base of the Highgate and Hampstead hills, in the north; the Norwood hills, in the south; and in the high ground about Kensington, Nottinghill, Shepherd's Bush, &c. As an illustration of the diluvium being mistaken for the true London clay, the cutting through Highgate-hill, on the archway-road, may be referred to. This cutting, so celebrated for the trouble it occasioned, and for the perpetual slipping which has been taking place in it, has often been quoted by engineers for and against the particular opinions of the day, in their evidence before Parliament and elsewhere. In almost every instance of this kind, to which we have paid any attention, the clay of Highgate-hill has been described as a part of the true London clay formation; and it was even thought by some, when the work was in progress, that it belonged to the plastic clay which lies below the thick mass known as the London clay.

An opposite kind of error, not less in magnitude than this, is said to have been entertained during the early progress of the Thames Tunnel, which was supposed to lie in diluvial clay resting upon the general mass of the London clay formation. It was afterwards ascertained, however, that the miners were working in a level, which, geologically considered, is 300ft. lower than what was at first supposed; that, in fact, the work was traversing the sands of the plastic clay, and the bottom of the tunnel was very little above the chalk, instead of being separated from it by the whole intervening mass of the London clay. Geological knowledge has served to show that in both these cases the earlier suppositions were erroneous. The Thames Tunnel is in the plastic clay, when it was thought to have been in a diluvium separated from the clay by another considerable mass, which is there entirely absent; and, on the other hand, the Highgate cutting, instead of being in the true London clay, is now acknowledged to consist of the diluvium which covers it.

The history of the attempt to drive a tunnel through Highgate-hill is almost too well known to require repetition. It appears that Trevithic, the great Cornish engineer; Vasey, another talented engineer of that day; and some others, were engaged in this work. Mr. Vasey had the fortune to be the promoter of the plan which was eventually taken up, and for which capital was actually subscribed, and an Act of Parliament obtained. In due time the works were commenced: they had been let by contract to persons of considerable experience in mining, and a drift-way was formed for some distance into the hill, as a preliminary measure to carrying through the main tunnel, which was to have commenced near Whittington's almshouses, where the present archway-road turns off, and to have come out near the Wellington Inn, after passing more than a mile under-ground. It was soon found, however, to be a work not easy of accomplishment, at least within the means at which the engineer had estimated its cost. Besides this, the thickness of brickwork which had been adopted was very insufficient. It is probable that the contractors availed themselves of this defect in the design, to rid themselves of a work which they saw would prove both troublesome and unprofitable. Certain it is that they omitted to pound and ram in a proper manner the jobbing or filling-in stuff, which had to be placed between the brickwork and the solid ground, in consequence of the area excavated being larger than that occupied by the brickwork. Settlements, therefore, took place; and so great a crushing force came upon the raw brickwork, that a considerable length of the tunnel fell in or collapsed, and several persons were killed. This accident damped the ardour of the subscribers; the contractors wormed themselves out of their contract; and it was clear that if the works of the tunnel were to be resumed at all, their cost would greatly exceed the original estimate. This and other considerations led to the abandonment of the tunnel scheme, and the subscribers eventually decided on an open cutting through the hill, following a line more to the east than that proposed for the tunnel. The open cutting was accordingly executed; the short archway now existing on this road being merely a bridge with rather a long barrel or arch, for carrying the Hornsey-road across the line of the great north road. Ever since this cutting was made, up to the present time, the slopes have continued to slip at occasional intervals, commonly occurring after wet weather and frosts of long duration. The clay in this cutting is soft and unctuous, and yet a great deal mixed with sand, which is scattered through it, not only in grains and thin partings, but in beds of partial extent, and in deep pit-holes, which admit large quantities of water to exert a strong pressure upon the clay in front of them.

For such a case as this it is difficult to devise a remedy, since experience has shown that here, at least, no slope within anything like reasonable limits will prevent the slipping. All petty attempts at drainage, by means of tile and rubble drains laid down the face of the slope, have been tried here, and all in vain. The quackery of sinking wells in order to reach some porous stratum which might conduct the water off, has also been tried, with no better success. It appears that, in consequence of the highly heterogeneous mixture of clay and sand which compose this cutting, any attempt to cut off the springs by surface drains or puddling would not succeed; and if the evil is to be cured by drainage at all, it is to be done by collecting and carrying off all the interior water just before it reaches the face of the slope. It is probable that nothing would more completely effect this than a trench carried up alongside the cutting at the back of each slope. This trench might be about two or three feet wide, according to its depth, and should be excavated at least as deep as the bed of the road, and should be filled up to the surface with large rubble or boulder-stones. It would thus serve to carry off all the water traversing the sands at the back of the slope, and prevent any of it from reaching the face; as there can be no doubt that the water will sink at once through the interstices of the stones, and, when arrived at the bottom of the trench, will flow quietly off. Such a work would no doubt be expensive; but it must be remembered that, with such precautions in the way of drainage, the slope in front need not be more than 2 to 1; and, considering the heavy expense of cutting back, and the various remedies which have been adopted, it is more than probable that the plan here proposed would have proved the cheapest, if it had been carried into effect in the first instance.

Highgate-hill is not the only place in which the kind of clay in question has occasioned great anxiety and expense, not only at the time of first cutting through it, but even many years afterwards, when no danger of its slipping was apprehended.

The cutting at the north side of the Tring summit, on the London and Birmingham Railway, consists partly of diluvial clay mixed up with rolled chalk and gravel. Mr. Stephenson has described it in his "Evidence on the Brighton Railway (1836)" as a very troublesome work. The cutting on the London and Birmingham Railway, between the Euston-square station and Camden-town, is a well-known example of a work in the diluvial clay. This cutting occasioned considerable trouble at the time; and, instead of being made with slopes, a substantial retaining wall, with a well-contrived curved batter on the face, was built on both sides of the railway to keep up the stuff. The wall has stood for seven or eight years without any symptoms of giving way, until, very lately, such alarming symptoms of bulging have appeared, that, at this distance of time, a very expensive work is being executed to prevent the wall from being forced in. Strong cast-iron girders are now being placed across between the two walls at short intervals, in order to resist the thrust of the stuff behind the walls. This instance will show the extreme caution which should be exercised in dealing with so treacherous a material, which can never be considered safe unless entirely protected from the influence of water.

The London Clay.

We come now to the true London clay of geologists; a stratification that must be viewed as very distinct from its diluvial covering, which we have hitherto been considering. The various strata of sand and clay composing it are more distinctly marked, also more uniform and regular in their outline, extent, and thickness; and its features are in all respects more massive, and more easily reducible to order, than the irregular assemblage of which the super-imposed diluvium consists. The greatest thickness of the London clay is estimated by geologists at about 700 feet; the upper part of which consists usually of yellow clay, with occasional beds of sand, while the lower member is an immense mass of dull bluish-coloured clay, of great stiffness and compactness. The yellow clay of this formation is a valuable brick earth, and is extensively burnt all round the metropolis; while the inferior mass of blue clay, wanting the requisite plasticity, is seldom used for pottery without an addition of other ingredients.

The London clay is of particular importance to the engineer, from the great magnitude of the cuttings through it, which are exhibited on all the railways and canals radiating from London in every direction, east, west, north, and south. Although the London clay has no visible escarpment or abrupt outline of high ground by which its course is defined, and although in many places it is completely broken through by large veins, and denuded throughout considerable tracts of country, it still happens that not a single railway or canal has been able to proceed ten miles from the metropolis without touching upon some part of this formation. Amongst the earlier of these works, the Regent's Canal, at the tunnel and cutting through Islington; the Paddington Canal, between Paddington and Brentford; and the Croydon Canal, in ascending to its summit on Forest Hill; all expose sections of the true London clay. The railways, again, which proceed northward and eastward from London, as the Eastern Counties' and the Northern and Eastern, pass through a long district of London clay, which occupies the high lands and forests of Essex. A great part of this district, as in Epping and Hainault forests, is covered by diluvial gravel from 5 to 25 or more feet in thickness. The railways to the west and north-west, as the Great Western and the London and Birmingham, intersect high ridges of the London clay at Acton and Primrose Hill. Lastly, the South-western Railway, and the Croydon Railway, touch upon several hills which are capped by the London clay; and the latter, particularly, has some very deep cuttings in this and the inferior plastic clay.

The slopes through London clay on the old canals were usually made at 2 to 1; and the cuttings being mostly of small depth, they stand very well at this inclination. It is not so, however, with the slope of the deep cuttings on the railways. These, although sloped at 2, and even 3 to 1, have been in a very unsettled and dangerous state ever since their opening. The cutting through London clay at the south end of the Primrose Hill tunnel, on the London and Birmingham Railway, is remarkably well executed, and has an excellent drain at the foot of the slope, as well as a low wall to prevent the base of the slope bulging out into the railway. The slope in this cutting is 3 to 1; and, notwithstanding the length of time since it was made, there are indications of future danger on the face of the slopes, which will require careful watching, probably for some years to come. We have already advanced the opinion that the true London clay is not so formidable, with reference to danger from slips, as the more irregular covering which rests upon it. This arises from the more limited proportion of sand which is associated with the real London clay, its structure being consequently less adapted to favour the percolation of water. The clay itself may or not be equally soluble with the yellow diluvium above it; but, however this may be, it is certain that the blue clay acts as a more effectual puddle against water than the other. In the great mass of the blue clay, the partings or seams of sand are extremely thin; and although they always occur at intervals throughout the London clay, and commonly preserve a parallelism and continuity which divide the strata into regular beds, they are often not observable except on very minute inspection. If, however, we take a newly cut section of the London clay, whether sloping or perpendicular, these very fine partings of sand, often only a few grains in thickness, may be detected throughout the mass; and, on looking closely, it will be seen that a certain quantity of moisture is diffused amongst the sand. The planes of clay in contact with these partings will also be found softer and more unctuous than the general mass, because the water has partially dissolved and mixed with the parts between which it has trickled.

This separation of the clay into beds by these very minute partings of sand, and this small quantity of water slowly working its way amongst the grains of sand, (appearances too microscopical to attract the attention of a careless observer,) are in reality the indications of that dangerous character which the London clay is known to possess. The incessant infusion of water which must take place, unless it is either naturally or artificially intercepted, lubricates the divisions between the beds of clay, at the same time that the sand is more or less carried away: and the obvious consequence is, that when these favourable conditions reach a certain height, a slip must take place from the sliding down of the mass of the clay upon the well-prepared, smooth, and unctuous inclined plane below it. The wonder here is, under such circumstances, and with a soil so constructed, not that slips occasionally take place, but that they are not much more frequent. Were it not that nature sometimes assists more than we have a right to expect, and that natural circumstances sometimes divert the percolation of water away from the face of the slope, so as to leave the partings dry, it is quite certain that slips in the London clay would be much more frequent than they are already. It is marvellous how blindly and injudiciously, artificial means are sometimes contrived to meet a case of this kind. We are at no loss to conceive that sloping back the ground to a flatter inclination is calculated in some degree to prevent slips in the London clay, inasmuch as it lightens the weight of earth which might otherwise be put in motion by the action of water, as already explained. Whether any dependence, however, can be placed in a very flat slope, is open to great doubt, because the flatness of the slope in no way alters that physical structure of the soil which favours the sliding of one mass down the inclined plane formed by the mass immediately below it. However flat any slope may be, the action of water in the partings still goes on; and whenever this action has so prepared the bed, by converting part of the clay into a soft and unctuous substance, as to have reduced the resistance of friction below a certain amount, the mass must slide down the plane by reason of its mere weight. Hence, although a slip may for the time be prevented by reducing this weight, it is, in all probability, only delayed till the inclined plane for the mass to slide on shall be still further lubricated, and otherwise prepared. The slipping of London clay may not inaptly be compared to the motion of a body descending an inclined plane on rollers; for, the sheet of water once formed in the parting between the beds of clay, so dissolves and combines with the clay and sand as to form a highly favourable surface for the superior mass to slide upon.

The practice of bevelling the slopes of a London clay cutting—that is, of forming it into several divisions separated from each other by a horizontal bench or berm, is, in our opinion, a more judicious expedient than cutting away the same quantity of land for the purpose of gaining a flatter slope. In either case, however, the waste of land is excessive, and the extra cutting very expensive.

Although the formation of a complete trench at the back of the slope, to be filled with rubble-stone, as described for the diluvial clay, is, no doubt, the most direct and certain method of curing the tendency to slip, it would be injudicious, on account of the expense, to recommend its adoption so universally in the London clay as in some others. The true London clay being comparatively regular and homogeneous, is far more easy to deal with than the irregular mixtures of sand and clay which cover it. Our own opinion is, that the tendency to slip in the London clay is commonly very slightly in excess of the resistance opposing that slip; and if even a very small artificial opposition be offered, the slip may often be prevented. Dwarf walls at the foot of a cutting may often be introduced with good effect; and if the slope be carried up at 2 to 1 from the top of the wall, the saving of cutting will probably pay the expense of the wall. Upon the whole, it appears, from all that is at present known of the blue clay of London, that slips in this stuff may be prevented by adopting capacious and well-puddled drains at top of the cutting, by giving a slope of 2 to 1 on the side *from* which the strata dip, and of 2½ to 1 on the side *towards* which they dip; and by immediately attending to any indications of movement which present themselves on the face of the slope. Whenever any thing of this kind is observed, an adit should be driven into the slope to drain off the water; the top of the slope should be hollowed back, and rubble-stones laid at the base of the part suspected to be in a moving state, with the view of opposing its thrust. If these precautions fail, and a slip notwithstanding takes place, there can be no use in any further temporizing; and the best method is, to cut the back trenches right through at once, and fill them up to the top with stones. This will prove an effectual remedy, and will be far cheaper than cutting back the whole slope all along the cutting.

Art. X.—THE STEAM FRIGATE "PENELOPE."

This leviathan is now completed; and it only remains that she may have a trial at sea to test her qualities and capabilities, before being turned out into regular service. We hope, for the benefit of steam navigation, that some *authentic* account of her powers may be published, and that the public may be no more imposed upon by exaggerated statements similar to those published shortly after her trial trip.

We subjoin the following particulars, which we believe will be found correct. The points relative to displacement, &c., are taken from Creuze's work; and though there may be some slight difference between the original "Penelope" and the 46-gun frigate here set forth, still the main points are the same; and, upon the whole, the vessel retains her personal identity.

Area of midship section = 540 square feet = 15·43 tons per foot × 62 = 956·66 tons. Load displacement = 1592 tons + 956·66 = 2548·66. Light displacement = 765 tons; length of load water-line = 153 feet; therefore, $\frac{765}{153}$ = 5 tons weight of material in each foot of length × 62 = 310 tons weight of material in lengthening. Estimating the weight of engines at 15cwt. per horse, we have

Original displacement	1592 tons.
Additional material	310 ,,
Weight of engines	525 ,,
Total . .	2427

2548 — 2427 = 121 tons for coals; allowing that she burns 6lbs. per hour per horse = 45 tons per day — $\frac{121}{45}$ = 2·7 days' fuel. Breadth at LWL = 40ft. 8in. × 62 = 2521 + 5260 (area of LWL before lengthening) = 7781 = area of LWL after lengthening = 18·52 tons per inch. Therefore, to enable her to carry 700 tons of coal, she must be immersed about 2ft. 6in. more. Midship port above LWL = 6ft. — 2ft. 6in. = 3ft. 6in.

The reader will perceive that the method adopted above for finding the weight of additional material, gives a very rough estimate of such weight, and is considerably under the real amount, which we should be inclined to consider nearer 400 than 310 tons, judging from the heavy nature of the material employed, and the quantity used. The additional furniture and stores of the engine-room, the paddle-boxes, and many other things, are not taken into account here; and the weight of engine is considerably under-rated at 525 tons. Altogether, ours is a very lenient estimate, and we hope a wrong one; *—but we shall see.*

Art. XI.—WOOD-PAVING.

We made some remarks upon this subject in one of our early Numbers, to the end of making known our sentiments relative to the practices of a set of litigious highwaymen, who attempt to defraud patentees of the fruits of their labour and ingenuity. These iniquities had, we remarked, notoriously been practised in the case of Mr. Stead's patent for wood-paving, for no sooner had Mr. Stead, after infinite toil and derision, given proof that wood paving would do, than his project was fastened upon by a host of shameless pirates, who have left no means untried to wrench it from his grasp. In this onset, however, we are glad to find they have been defeated; they have been driven back with loss and shame to the darkness whence they so suddenly emerged, and wise will they be to keep themselves there in all time coming. But as we have no greater faith in their wisdom than in their virtue, it may be as well to here set down a few miscellaneous suggestions, which if they do not scare these freebooters from their vicious courses, may at least deter every one who has a character to lose from giving any countenance to them.

We may first observe, that there has just been a trial at Liverpool relative to these piracies, and that a verdict has been returned in favour of Mr. Stead. It is contended, however, by his opponents, that the verdict does not establish the validity of his patent, but is merely confirmatory of certain contracts relative to wood-paving which certain parties had concluded with him. This allegation, every one who takes the trouble of reading the report of the trial, will see is not true; for the whole case is made to hinge on the validity or otherwise of the patent, and the issue of the trial, therefore, establishes the validity of the patent, so far as a trial can establish it.

But although the result of the trial is no doubt the just one, we think that event is due rather to the good sense of the jury than to the soundness of the judge. Who the judge was we do not know, for his name is not appended to the report of the trial from which we have derived our information; but whoever he may be, he is manifestly, in all patent matters at least, a man of most restricted ideas. His charge to the jury is a very superficial, and indeed in our eyes, a somewhat preposterous production; of this, however, our readers will be enabled to form an opinion for themselves by the following extract from the report of the trial:—

> "His lordship, in summing up, went over the several issues. He said the plaintiff complained of his patent; and it was admitted that if the patent was a good one, the defendants had exercised a right which belonged to him. The first important plea upon the record was that alleging that the plaintiff was not the true and first inventor in this country. If he had derived his knowledge from books, or publications known to the public, or from persons in this country, he would not be the true and first inventor under the statute. If, however, he derived his knowledge by a communication from abroad, and was the first person to convey the project into execution here, he would be entitled to the protection of the statute. In his specification it was recited that the plan had been communicated to Mr. Stead by a foreigner. Of this no proof had been adduced; but, on the other hand, no direct proof had been adduced by the defendant to show that these publications in this country had come to the knowledge of Mr. Stead. It would be for the jury to say, under all the circumstances, whether they thought he had such knowledge of them. If he had, the plan proposed by Mr. Heard seemed, as nearly as possible, identical with that of the plaintiff. It was not, however, sufficient on this plea to deprive a man of his patent, to show that another person had previously entertained the same idea, if the patentee had himself been the inventor, and had not derived his plan from the inventor who had preceded him. As to the sixth plea, that long before the patent was granted the invention had been publicly known in this country, there was a very great difference between a knowledge of it as a thing that would suit, and a mere experiment, resulting in the invention, being cast aside as impracticable. In such case, the party carrying it out might be the inventor. In the present instance it would be for the jury to say how far the paths, &c., spoken to by the witnesses, were laid down on the same plan suggested by the plaintiff. The most important case, certainly, was that at Sir William Worsley's, a block of which had been produced. There the pavement in question had been in use for a very considerable time: it had been used for carriages to pass over, and its existence had been a matter of common knowledge to the inmates of the house, or to visitors, or any person making use of it. Whether such a plan, if publicly made use of, had been used by one or six, made no difference; and, in his opinion, if the jury should think the two plans identical, there was an end of the patent. That, however, was a matter for their consideration solely. The jury, after being shut up for nearly two hours, returned a verdict for the plaintiff."

Now it is quite clear to us that there is a vein of unsoundness running through the whole of the preceding argumentation, arising from a want of discrimination between that species of patent which is based upon a *thing discovered*, and that based upon a *thing done*. It is impossible that in patents such as wood-paving there should be such a thing as invention at all in the vulgar sense of the term; for the use of wood, as well as of countless other substances, as a material for paving, must have occurred to every mind. The mere conception, therefore, of wood as a material for paving, or the communication of that conception, is a point incapable of interfering with the validity of Mr. Stead's patent, simply because in the mere proposal of the application there is no merit, and consequently nothing to justify a previous claim. To put a parallel case: suppose that at the present time glass were to be proposed as a material for paving; the proposition would of course be laughed at, and though proposed by ten, twenty, or a hundred successive persons, it would still be treated with derision. We may further suppose that every person in the kingdom was made acquainted with the nature of the absurd proposal, and we shall then have a case analogous to the most unfavourable case that *is sought* to be made out against Mr. Stead. But, suppose that some ten or twenty years hence a person were to spring up, who, after great expense and an infinite number of patient trials, succeeded at length, after many failures, in bringing the glass to bear, is that person to be deprived of all the fruits of his toil and perseverance, because some non-productive theorist had a number of years before mentioned glass among the thousand and three materials which he conceived might become applicable to paving purposes? If this be law, the sooner that laborious and indefatigable race of men by whom inventions are brought to bear, are put in possession of the fact, the better; so that they may desist from the developement of their inventions, which no doubt some visionary or other said might be developed when enumerating thousands that never will.

We might say a good deal upon this subject, did our space permit. As it is, we must content ourselves with the very obvious remark, that there are some plans, the feasibility of which is discovered as soon as stated; and others, which though explained most fully, fail to make a single convert. In the former variety, it is right to hold that where the plan can be proved to have been communicated by another person, the patent is invalid; but the fullest communication can signify nothing when it fails to bring the realization of the scheme one particle the nearer. Of this last class of projects, wood-paving is one, and the question to be determined is, not who proposed wood-paving? but, for all practical purposes, who brought it to bear?

Art. XII.—OUR CLUB. No. VII.

Hail, conversation! heaven-born art!
To us thy magic aid impart.
Let no rude accents mar the hour,
Held sacred to thy gentle power.
Freely we yield us to thy sway,
To rove where'er thou lead'st the way:
Whether to soar to Science' height,
Or wing through fancy's realm thy flight,—
We'll follow thee—away! away!
This is our monthly holiday.

Scene.—*The Club Room.*

Present Sir Jonah *seated. Enter* Montgomery *and* Scalpel.

Sir Jonah. Good evening to you both. Our punctual Dutchman (pointing to the clock,) had just given its warning click, announcing the time which I had appointed for our meeting to be at hand, when you entered the room.

Scalpel. There is something, to me, inexpressibly solemn in a clock.

Montgomery. Especially when it is an old friend, whose warning voice has been long sounding time's requiem in our ears. It wears, too, an air of imperturbable gravity, as though conscious of its important office.

Scalpel. Look at yonder horologe, now, with its unrelaxing visage, as solemn as old Time himself, of whom it is so faithful a chronicler; with its monotonous tick, tick; measuring the moments with the same even cadences, whether to mortals they be winged with joy, or creep tardily along,—in pain and sorrow.

Sir Jonah. Yes, the poet is right:—

"We take no note of time
But from its loss: to give it then a tongue
Is wise in man."

Yet, strange infatuation! having made these chroniclers of time, and stuck them up as household deities, we are, for the most part, altogether regardless of their high moral purpose. To the ordinary pursuits of life, it is true, they are made subservient. Meals are prepared, and families gathered around them, men go to and leave off their employments, and appointments are kept by aid of the clock. But by how few is this telegraphing, and rendering palpable to our senses the flight of time, appreciated as it should be. It seems as though the skill of man in this had in some degree foiled itself. By taking off the attention from the natural markings off of time's flight, afforded to us in the succession of day and night, and the change of the seasons—and fixing it almost solely upon this artificial measurement, in which one hour is the precise counterpart of the other, we are apt to let life slip from us unaware.

Montgomery. So the minute division of labour of modern times, which might, and should be made subservient to man's greatest good, is too often a cause of his degradation, by mechanising the soul, and cramping it within the narrowest possible limits.

Scalpel. If my quondam associate, Mr. Feelose, were here, he would tell you that this disregard of time is owing solely to the invention of watches. "A clock," quoth he (and therein I agree with him,) "is a venerable, time-telling, conscience-pricking memento, exacting our respect perforce; but a different thing altogether is that minature plaything, a watch, bedizened over with tinselly gewgaws: its very pettiness, its toyishness, breeding contempt—the contempt of familiarity. The heathens," he would say, (he had, as you well know, a queer knack in applying similes,) "the heathens may reverence their Juggernauts and the huge idols in their temples, but how is it possible that they should venerate those miniature gods they carry about their persons—things that you might put into a corner of your waistcoat pockets? Just so do watches breed contempt, first for themselves, and then, as a natural consequence, for the precious time which they so impertinently, and in such an off-hand jauntiness of manner, presume to chronicle.

Montgomery. Ha! ha! in your feeleosofing vein, I perceive.

Scalpel. Nay, I protest—Mr. Feelose is—

(*Enter* Waiter.)

A letter for Sir Jonah.

Sir Jonah. For me personally, and not in my editorial capacity? Ah! I see; from my dear college friend, Tom Baring, whom I have not seen for many a year; a curate, passing rich—not on forty, but a hundred pounds a year. Though located in the North of Devon, he has heard, it seems, of our Artizan, and bestows warm praise upon its management. "It will do much," he writes, "to unmaterialize the working classes—so long looked upon and talked of, ay, and treated, too, by political economists as so many machines, mere wealth producers, that the living soul is well nigh extinct." Oh! that his predictions may be verified, that the Artizan may be the lever that shall elevate the working people of England, and infuse into them a sense of their true dignity as men?

Montgomery. I trust it will do so.

Scalpel. It shall—it must—if there be power in words, and men's souls be not thoroughly imbruited.

Sir Jonah. (Musingly.) Thy praise is sweet indeed, because I know that it proceeds from a heart sincere, and a judgment singularly strong. How often have I reproached the system by which thou, with thy kindling eloquence and Christian life, art kept in obscurity, whilst the "fat, smooth, oily men of God" sit triumphantly aloft in the hierarchical chair. How wide the chasm between an archbishop and a village curate! one the companion of kings; the other, of tillers of the ground, hewers of wood and drawers of water.

Scalpel. Bear with me. I must needs improvisatrise on the subject:

The heart of pity bleeds for thee,
Poor starveling on a curacy!
As it beholds thy sad condition,
Worse paid than meanest mechanician.
Serf of the church! who sows in vain,
While others reap the golden grain.
The rector's *fag!* who, freed from school,
Still feels himself another's tool.
To him grim Poverty guards o'er,
And warns from matrimony's door;
And Prudence, with her frigid frown,
Keeps all his wedlock wishes down.
Condemned to single blessedness,
No helpmate meet,
With counsel sweet,
Hath he his lonely cot to bless—
No children dear,
His soul to cheer,
With their fond prattle and caress.

Montgomery. Yes, *Bachelor* (of Arts,) through life he goes,
A bearer of his own and others' woes.

Sir Jonah. Ah! such privations are not the subject for a pun. Yet the feeling of pity is misplaced on objects like my friend Baring. Oh, if you had seen him as I have, moving the even tenor of his way, discharging his priestly duties with holy zeal; respected by his rich neighbours; beloved, almost adored by the poor, among whom he walked like a beneficent genius, assuaging their local evils—tempering the bitter spirit which poverty is so apt to engender—the patronizer and active promoter of all good undertakings—the mediator between rich and poor; not a mere pulpit priest, but one who carries religion into the daily walks of life, making it a practical living principle: had you thus seen him, envy (if envy were compatible with the reverence due to his saintly character,) rather than pity, would be the fitter feeling. No, no: it is not for him that pity is to be awakened; but for the Church, for the world at large, which are losing the benefit of powers so transcendent, and which should have for their exercise a less circumscribed sphere. I do not dispute the general truth of Scalpel's view; but in my present mood it grates. Cannot you, (turning to Montgomery,) wake a strain which shall be more in harmony?

Montgomery. I will willingly try.

1.
The Parish Priest! O noble name!
O sacred calling! dear to fame—
Not the vile breath to heroes given,
Which tyrants seek, and villains claim;
But that which forms the good man's aim,
Th' immortal heraldry of heaven!

2.
All honour and all glory due
Be paid to those—the righteous few—
That, to their solemn office true,
From pomp of worldly fame remote,
Their lives to works of love devote;
Who more than merely pray and preach;
Who *act* the gospel, and thereby
In conduct practically teach
Both how to live and how to die.

3.
"Salt of the earth!" illustrious band
Of bloodless heroes! Lo, they stand
With sword and olive-branch in hand,
Marshall'd beneath their Lord's command:
Like polish'd mirrors bright,
Reflecting heavenly light
O'er the dark corners of our land.

4.
Blessings and praise be ever theirs,
And angels' smiles, and good men's prayers,
The tears of penitence,
Sighs hush'd in poverty's abode,
And death-beds lighten'd of their load,
A moral frankincense
From the heart's altar shall arise
To heaven's High Priest, fit sacrifice,
And call down blessings from the skies.

Sir Jonah. Thanks, my young friend. I thought I should not call upon you in vain.

Scalpel. I enter my protest against it. Excellent as the lines are—as, indeed, every thing is sure to be that comes from you—(*bowing to* Montgomery)—still the view is incomplete; and, as the rhyming fit is upon me, I shall take up the strain where you left off. Here goes:—

1.
Alas! but other priests there be,
"Hirelings" who seek the golden fee;
Careless of every thing, so they
May pocket quietly their pay.
"Wolves in sheep's clothing," who affect
For mother Church profound respect;
Who call it sacrilege to seize
Aught of her temporalities;
And who, in matters spiritual,
Would fain be thought a perfect jewel;
Whose looks your very soul would freeze,
If in the church you chanced to sneeze;
But who, in matters monetary,—
Look sharp, my boys! will never spare ye:
Creatures of form and ceremony,
Relentless, as 'tis said, the drone bee,
That kills the bees, then eats the honey;
They fleece the flock, in, out, of season,
'Gainst rule and right, and rhyme and reason;
And think it nothing less than treason
For any wretch to dare refuse
Paying the Church's utmost dues.
Their favourite doctrine, decimation,
Forms their whole sum of calculation.
Well-pamper'd pluralists may bawl,
"The Church wants no reform at all!"
While their fat livings every year
Pour in their laps four thousands clear;
From which the paltriest sum they grudge
As stipend for their letter'd drudge;
Thinking (O shame!) the merest pittance
For their lank curates, full acquittance.

2.
Enough! enough! I did intend
Each separate evil to disclose;
But I'm too much the Church's friend
Her nakedness to all t' expose:
I leave that to her ruthless foes:
Why should I mar what I can't mend?

3.

The Church hath many grievous blots,
I really needs must say:
So hath the Sun its divers spots,
Yet bless we still its ray;
Nor love, on that account, the night;
But hail with joy the coming light
Of each new-risen day.

4.

So be it with the Church: though she
Lacks somewhat of her purity,
Let 's not forget
That in her lineaments there shine
Bright symptoms yet,
That speak her origin divine.

There—I trust I have made the *amende honorable* by the concluding verses.

Sir Jonah. Certainly, the *close* of your Hudibrastic strain pleased me most.

Scalpel (*bowing low.*) I appreciate the compliment. But let me tell you, Sir Jonah, you brought the infliction on yourself by your contemptuous treatment of my first effort.

Montgomery. Whilst upon this subject of church discipline, I would observe—although, of course, desirous that the utmost freedom should be given to men's thoughts on a subject so vitally important as religion, and that the freest scope should be allowed to the Voluntary Principle—that I cannot join in the apparently immitigable hostility of a large body of the Dissenters against the Church as by law established. I do not understand the ground of their objection, *on principle*, to pay towards a mode of religion differing so slightly from their own—the very same in all fundamentals. As a matter of pounds, shillings, and pence, it is all clear enough; and so far I go with them; but, when they talk of principle, I acknowledge, it staggers me. Weighing the whole matter deliberately, I am inclined to acquiesce in the propriety of having a State religion.

Scalpel. And I am wholly for the Voluntary Principle. I think it all-sufficient. See what it has done, and is still doing, throughout the length and breadth of the land; nay, see what it has done, and is doing even in the Church itself, which anathematizes it as a foul heresy.

Sir Jonah. Voluntaryism has doubtless done much good; and has forced itself, as you rightly say, into the very heart of the Church, as it were, in spite of itself. Hence its National and Sunday-schools: hence its Sunday evening lectures: hence its missionary societies, and all its other means of propagandism, now actively at work. All these—there is no gainsaying it—are of Dissenter extraction. These flowers, now fostered so carefully by mother Church, were originally the growth of heresy, transplanted into the Church's pale as a means of self-preservation. But, whilst admitting all that the most ardent disciple of Voluntaryism—even yourself, Scalpel—can urge in its behalf, still I think it behoves a Christian State to cause to be upholden some one form of Church discipline; and not to leave *all* to chance efforts.

Montgomery. Dissenters are exceedingly fond of putting questions of this purport: "Can it be that the work of God needs the adventitious aid of human institutions? Must the ark of the Lord, to be secure, have the protecting wing of Government thrown over it?" To questions such as these it is surely sufficient to answer, that Omnipotence has thought fit to work out His ends by means of human agency; and which, indeed, is not the less called into requisition by Voluntary exertions than by the instrumentality of a Government.

Sir Jonah. Without entering at length into this much and violently-debated subject, I would remark that I believe the present system might be made to work extremely well, by the removal—easily effected—of that most pregnant cause of heart-burning, church-rates. "Voluntaryism has more of energy with it." Admitted. But then it is of necessity fickle, liable to be swayed by the passing breath of every new doctrine. Whereas, State-churchism, in its very immobility, has the groundwork of stability. Each is wanting in what the other possesses: what then remains but to amalgamate the two? Let the greater energy of the one be a perpetual spur to the other; which, in its turn, will act as a check upon fanatical excess. But what most is needed, in this as in all other things, is that men should have charity (in the scriptural comprehensiveness of the term) one towards another. We should not be perpetually dwelling on our points of difference; we should rather see in how many points we can agree, than by trying, as is usually the case, to pick out differences, and to make the most of them. What we want, in short, is a more catholic spirit, both in politics and in religion. Differences of opinion there must needs be, from the very constitution of our minds, on a thousand subjects. What is truth to one mind is not so to another. Seen from different spots, and through different media, the same object will appear different. If Christian sects had but a little of that "charity which thinketh no evil," so strongly inculcated by their Divine Master, what a heaven might there not be upon earth.

Scalpel. Yes, this spirit of catholicity is the one thing needed. Thoroughly impregnated therewith, I conceive that, either in a Roman Catholic, or a Church of England, or a Methodist, or a Quaker place of worship, or with any of the thousand and one denominations of Christendom, one might lift his soul in devout adoration to the one true God, clearly recognizable in all, worshipped though he is in forms and ceremonies so widely differing.

Montgomery. Even as through the fantasies of dress, and the natural differences impressed by climate and living, we everywhere readily distinguish the great family of man.

Sir Jonah. My reverend friend's letter has been the cause of some serious and, I trust, not altogether unprofitable talk. During my rustication with him, which was for some weeks—for I was then slowly recovering from a severe illness, the result of over study, and therefore more susceptible to sweet sounds than I should perhaps have been in robust health—I was particularly struck with the excellent congregational singing of the church at which Baring officiated. He is possessed of an exquisite taste in music, and a voice of surpassing power and melody; so that it is no wonder he strove earnestly to cultivate a taste for music among his flock; although, no doubt, he had a higher purpose in view than his own gratification: he knew well the value of music as an aid to devotion—he knew its humanizing effects upon the mind. And in his success he must have felt amply repaid. Never did music, before or since, so devotionalize my entire being. There was no rant, no vulgar twang, so commonly heard in uncultivated voices, however good—no sudden starts and catches. All was simple, flowing, and purely correct, showing plainly what labour must have been bestowed to attain so much excellence with such materials.

Montgomery. I have been often disgusted in places of worship with the exhibition of a choir stuck up aloft, having the music (such music as it was) all to themselves; the congregation looking on in a kind of stupid amaze, as voice chased voice pantingly through the giddy mazes of the most complicated harmony.

Scalpel. More befitting a glee-club than a place of worship.

Montgomery. How different in its effects from that to which you have just adverted—the united voices of a whole congregation uplifted in devout thanksgiving.

Scalpel. That visit of yours, Sir Jonah, must have been delightful in many ways.

Sir Jonah. It was. My love of the picturesque had ample food. The place, as I have told you, was in the North of Devon. It was on the coast, which, you know, is noted for its romantic beauties. The lower hamlet (for there were two) was level with the beach. The upper, to which access was obtained by sundry zig-zag paths worked out on the face of the rocks fronting the channel, was sheltered, fairly nestled, in a small coomb, or hollow, close to the summit of the rock, completely sheltered from the biting north wind. The church stood on the highest point, as though it scorned all protection. And most magnificent was the view, as you leaned over the churchyard wall, and saw, far, very far below you,

"The crows and choughs winging the midway air;"

and the sailing vessels gracefully working their way obliquely or directly, as the wind served for their several destinations; and the steam-vessels going straight ahead to and from the opposite coast, and up and down the channel, as though in very scorn of the winds and waves—neither courting their alliance nor fearing their opposition—forcing their way irresistibly, like things of destiny; the long trails of smoke which they left behind them gradually dissipating as the heated air, cooled down to the surrounding temperature, deposited its sooty particles. Around you on every side, landward, you saw huge fragments of rock piled in wild disorder, giving you the notion that the Titans had fought there a pitched battle.

Scalpel. But the people—the inhabitants of this sequestered spot—did you get no insight into their character? Did you open no new leaf in the mysterious volume of human nature?

Sir Jonah. I did—to me a delightful leaf. I saw toil, if not of the severest, at least of the most ill-paid kind, lightened of its load by the full exercise of the domestic affections. Drunkenness was not there, with his accursed hoof-mark, trampling out all kindly feelings from the soul. The spirit of their beloved pastor had passed like a purifying spirit throughout that little community, interpenetrating all hearts.

Montgomery. No people is deserving the title of civilized in which the home affections are not fully developed.

Sir Jonah. Even so. The germ of national elevation is certainly to be found in domestic purity. *From the hearthstone alone can a healthy patriotism spring.*

Scalpel. And you really had a glimpse of something like Arcadian simplicity and innocence during your rustication?

Sir Jonah. I had. Not the Arcadia of namby-pamby poets, who know little of nature, and less still of human nature—made up of shepherds and shepherdesses eternally piping, as though life were a jig to be fiddled through; but a genuine, matter-of-fact Arcadia, made up of honest-hearted love in husband and wife, parent and child, brother and sister, and all the various relationships of life—constituting the only true poetry of life. Many instances I was told by my friend—for he was the depositary of most of their joys and griefs, and knew, I believe, the history of most there—many instances he gave me of their homely virtues, and especially of womanly endurance and constancy.

Scalpel. It is strange what power woman can and does exercise over the impulses of her heart. No general marshals and directs his army—no monarch holds sway over his subjects—no chemist modifies the powers of nature—with half the force and skill that a maiden holds control over herself. Talk of man's inflexibility—pooh!

Montgomery. A beautiful spectacle it is to contemplate a woman's heart. So delicate, and yet so strong. Swayed like a reed by the slightest breath; yet firm as the mountain oak. It may not be unaptly compared to those Druidical remains, termed rocking-stones, which yield to the slightest impulse of the summer breeze, but which the fiercest blast of winter cannot overturn.

SIR JONAH. There is a spice of coquetry in every woman's heart, perfectly compatible with the most engrossing love; and in the sunshine of prosperity it is often given way to rather too freely. But, let the clouds of adversity lower over the loved one—let pain and sickness afflict him—let censure and the world's frown darken his fame—then shines forth the love of woman in all its holy and self-sacrificing character. Then has she no eye, no ear, no thought for other than him. And if, by the most unwearied attention, she can mitigate aught of his grief, or lessen one throb of his pain, sweeter is it to her heart than the homage of ten thousand tongues.

MONTGOMERY. Verily, love is to life what the sun is to the natural world. How cold, and bleak, and desolate would life be without love!

SIR JONAH. It is pleasant at times to mark the course conversation will take. Some incident in itself, perhaps, trifling, first awakes the current of thought, and gives it a certain bent; and then the stream rolls on now in light, now in shade, winding this way and that, according to each one's particular bias, increasing by the accession of other streams, or itself a subsidiary rill merging in some other; or swallowed up for a while, it may be, again to gush forth at no distant spot, and flow on rejoicingly.

SCALPEL. I have often been roused from a fit of melancholy by the stimulating talk of others—thought producing thought, till my sluggish nature has been thoroughly roused. In such cases, I liken myself to a boat which is stranded in some tidal river, while other boats lighter, or more exposed to the tide's action, shoot rapidly by. So, persons free floating gaily along on the current of conversation, whilst I sit in moody silence. By degrees the tide reaches even me, till by and by I feel myself fairly afloat on its exhilarating influence, and skim along as gaily as any.

MONTGOMERY. I suppose we are to consider you fairly afloat to-night?

SCALPEL. I am sure never to be otherwise in such company.

(*Enter* PRINTER'S DEVIL.)

"Please, Sir, the compositors are standing for want of copy; and the printer told me to tell you that, now you sell so many, the *Artizan* won't go to press in time if you don't send all the copy directly."

SIR JONAH. Yes, the compositors must be kept afloat—eh, Scalpel? Well, boy, you shall have some copy speedily. Here (placing his hand upon a curiously contrived box upon the table, into which, during the dialogue, he had been observed both by Scalpel and Montgomery, to put occasionally a sheet of paper) here is my invisible copyist, my magical reporter. Here, gentlemen, is an invention which I have only to get patented and concoct for it some Greek compound to ruin all reporters, and to make my fortune and immortalize the name of Sir Jonah. Ay, well may you start with surprise. Listen. (Rising with great dignity, holding the box in his hand.) After profound study and intense application, I have succeeded, by a combination of chemical and mechanical agents, in producing an instrument by which words as they drop from the speaker's tongue, shall imprint themselves on paper.

MONTGOMERY. Why this out-daguerres the Daguerreotype.

SCALPEL. Auricular confession with a vengeance.

SIR JONAH. Nay, more. 'Listen intensely.' By divers alterations which I purpose making in printing, and by the use of musical annotation, the printed page shall be, so to express myself, rendered *vocally visible*, so that the reader may see not only the mere words but the tones in which they were uttered: the humorous by-play—the passionate appeal—the earnestness of entreaty—all, all shall be visibly stamped upon the printed page, so that you may as it were take in sounds through the eye. But of this important invention more anon. Meanwhile, here goes the first specimen of this infant art to the printer's. Here, boy, hurry off. (Takes out some sheets of paper, apparently closely written, and gives to the boy, who retires in amaze, holding the paper very gingerly; evidently thinking of "Doctor Faustus and the Devil.")

Curtain drops.

ART. XIII.—THE NEW PLAN OF STEAM-BOAT BOILER.

A NEW variety of steam-boat boiler has, during the last year or two, been gradually coming into use in the steamers on the Thames. It is now being extended to sea-going vessels, and it is not too much to expect from its introduction a complete revolution in the art of navigation by steam. Our readers will of course expect from us some account of a novelty so important, and we shall here endeavour to meet their expectations.

The variety of boiler, to which we allude, is of the locomotive kind, that is the flues consist of locomotive tubes, the furnaces being arranged much in the way usual for marine boilers. The boilers, however, are much stronger than usual, the shell and furnaces being of extra thick plate, and the sides and ends are very firmly stayed. The configuration and general arrangement will be understood by a drawing we shall give next month, which however, does not pretend to be drawn to a scale, or to give exact sizes.

The purpose of this plan of boiler is to enable marine engines to be wrought with a higher pressure of steam than at present, without additional danger; and thereby render practicable the full development of the expansive system. A great saving in fuel will thus be accomplished, as well as a large amount of *boiler* room. Indeed, boilers *of the same power*, on this new construction, will not take up more than half the room occupied on the former plan.

There are two objections which will present themselves to practical men, relative to the use of locomotive tubes in steam vessels—that they will become encrusted with scale, and that soot will accumulate within them. These objections are not found, in the actual application of the plan, to have much weight. The scale, it appears, does not adhere with the same tenacity to brass as to iron; and even in the case of iron flues, the use of the brine pumps prevents any considerable deposition of scale. The use of Welsh coals in the furnaces, again, obviates any material settlement of soot in the flues, and whatever soot may be deposited is easily removeable—a door being left in the front of the boiler to permit easy access to the tubes.

We ought to observe, that it is to Messrs. Miller and Ravenhill, we believe, the introduction of this new variety of boiler is due. The boilers of the *Blackwall*, *Prince of Wales*, and other vessels, constructed by Messrs. Miller and Ravenhill, are of this description; and the same makers are now constructing a set of these boilers for the *Infernal*, a new Government steamer, now being fitted with engines. This will thoroughly test the qualities of the boilers for the uses of sea-going steamers; and of their success there cannot, with the experience already before us, be the slightest possible doubt.

ART. XIV.—ARCHITECTURAL TASTE.

THE taste intellectual, as well as the taste organic, is more materially affected by habit than perhaps by any other agency; and habit, in this instance, is only another word for association. The palate may be trained to a relish of the most nauseous substances, as every one must know who has had the resolution to overcome a quid of tobacco. The Greenlander is in like manner brought to relish a feast of train-oil, though he probably would turn with aversion from the choicest of our viands. As it is in the physical, so it is in the spiritual man; for here, as surely, taste may be elevated or degraded by the nature of the culture it may happen to receive. Some men there are whose organic taste has been so quickened by use, or, in other words, by cultivation, that they are enabled to detect the minutest differences between the most nearly identical flavours—such, for example, as the wine of different vintages, and the quantity of tea of one particular kind in a mixture of different samples. In literature, again,—and, indeed, in the whole of the fine arts,—a similar delicacy of taste, or rather of perception, is occasionally to be met with; and those powers, which to ordinary observers appear well nigh miraculous, are traceable altogether to a careful cultivation. A taste in architecture is to be acquired by the same arduous and persevering toil as a taste in more vulgar things; and there is no man, if his heart be only warm, and his intelligence of ordinary quality, who, if he only resolve, may not arrive at a fine taste in the particular walk in which he aspires to renown.

ART. XV.—STEAM COACHES ON COMMON ROADS.

WE have adverted, on several occasions, to the evil influences exerted by railways in this country under their present administration; and expressed, at the same time, our fervent hope that some antidote would be found against the perpetuation of such injuries. We remain as firmly as ever of opinion that the whole railways of the country should be taken into the hands of the State; though we should be unwilling to see that measure adopted, unless accompanied by the imposition of such checks to venality as would prevent the railway management from degenerating into a manufactory of jobs and places. But, pending this consummation, we would direct the attention of our readers to a different instrument of locomotion, which appears capable of counteracting, to a great extent, the tyrannies of the railway system. The appliance to which we allude, is the use of steam-power on the common roads—an expedient attempted to be carried into practice many years ago, but which failed to realize at that time a successful result, owing to the combined opposition of the furious railway mania, then epidemic, and the imperfections attaching to the various steam-carriages then brought forward. The present juncture, however, promises greater success, as public feeling, as well as public opinion, is now beginning to run strongly and stedfastly against the railway system: in addition to which, we believe we shall be able to give a design for a common road steam coach, which, by its freedom from the vices attendant upon the plans brought forward heretofore, at once removes the difficulty arising from their imperfections. In short, we are of opinion that the time has arrived when steam coaches on common roads may be employed with success; and we are anxious to be the herald of that blissful consummation.

Before, however, we advert to the particular kind of steam coach we would recommend, we beg to draw attention for a moment to the injuries the railways are inflicting. The tyranny exercised in the transport of the poorer class of passengers, after having first wrought the ruin of all other means of conveyance, we have animadverted upon on other occasions; but we have not yet mentioned the grievous loss and injury inflicted upon the humbler class of towns in every part of the kingdom, by depriving them of the traffic which constituted their wealth, and leaving them in loneliness and desolation. Formerly, thousands of coaches intersected the kingdom in every direction, scattering wealth and animation in their train. But now the road, with its fragrant hedge-rows and picturesque cottages, is deserted—the inn, where the coach stopped, shut up—the lives of thousands disarranged, and fond associations broken for ever. We do not say, be it observed, that if the balance were struck between the benefits and injuries of the railway mode of conveyance, the benefits would not preponderate,—though neither should we assert that they would. But our neutrality would only be afforded on the supposition that railways were managed for the public advantage: and when we come to take railways as they are, we do say, that, in this country, they have been an injury instead of a benefit.

The great obstacle heretofore experienced to the success of steam-carriages on common roads, has been the impracticability of hanging them on efficient springs. This is a more difficult thing to do than might at first sight appear; for at the same time that there must be a rigidity between the cylinder and the axle to transmit the engine power, there must be a flexibility to enable the springs to act. If the springs be impeded in their action, or be too strong and rigid, the machinery will be soon knocked to pieces in consequence of the concussion of the road: while again, if we suppose the springs to be sufficiently elastic to obviate this evil, and that the cylinder and axle are directly connected, the springs will yield with every stroke of the engine; and the alteration in the relative positions of the axle and cylinder, consequent on this movement, will cause the piston to strike with violence the cylinder top or bottom. This striking of the piston may, indeed, be obviated, by making the cylinder of an extra length; but this, again, involves the evil of a great waste of steam, and introduces excessive complexity into the valve gearing. Here, then, steam coaches on common roads have stood in a dilemma they have not as yet been able to overcome,—they have not been able either to avail themselves of efficient springs, or to do without them; and we are thoroughly assured that they cannot be successful until this difficulty has been completely surmounted.

It may be asked, how is this difficulty overcome in the case of railway carriages? We answer, badly enough: but there the great flexibility of the springs is not so imperative, the surface of the road being not nearly so uneven. Railway carriages, therefore, manage to get on with bad springs; but this, in the case of coaches on the common road, is not possible. They must have good springs, or they will not do at all.

It has been proposed to introduce wood paving upon our highways, so as to enable steam coaches to travel upon them successfully. We think favourably of the expedient on great lines of thoroughfare; but, in the great majority of cases, the expense of the wood paving would, we fear, be a barrier to its employment; and even in the cases where wood paving is applied, we think the employment of springs indispensable. This, indeed, will at once be made apparent by observing the action of the springs of an omnibus running over the paving of any of our wood paved streets: the springs, even there, will be found to have good work to do.

The particular form of steam coach we would recommend is shown in Plate XXVIII.; and the nature of the contrivance by which a free play to the springs is made consistent with the right operation of the piston power, will at once appear on inspection. The variety of boiler we have adopted is that invented by Mr. David Napier, and used in a number of steam vessels on the river. It is light, strong, and compact; carries little weight of water, and produces a plentiful supply of steam: it also admits of being easily repaired. Of the other parts of the plan we have no room to say anything; nor is it necessary that we should, for the drawing makes them abundantly plain, with the aid of the following references:—A A A, boiler; B B, tank for feed-water; C C, firing space; D D, frame for supporting boiler; E, cylinder; F, wheel for steering; G, driving wheel; H H, steering gear; I, lock-up safety-valve; J, spring balance; K, chimney. The passengers are manifestly not carried in this coach. It is, indeed, a mere *steam horse*, the passengers being conveyed in a coach or coaches behind.

Our limits only enable us, in addition to this, to explain, that the connecting-rod is attached immediately to a crank or link fixed on the upper carriage; and from thence the motion is conveyed to an intermediate crank or link, fixed neither to the upper or under carriage, but to the extremity of a jointed iron, like a great pair of compasses, situated between them. From this last point the motion is conveyed to the crank which turns the wheel; and a moment's inspection of the Plate will show that the upper carriage may be depressed or elevated, or moved, indeed, in any direction, without vitiating the movement between the wheels and engine. The link joints are, of course, of the ball-and-socket description, and a socket and universal joint are introduced into the steering spindle. The accommodation of the power to the resistance, so that a greater power may be given out in ascending hills, is accomplished by a variation in the degree of expansion; an expedient presenting no difficulty, and already practised in steam navigation. Such is the ARTIZANS' steam coach; and with such a parentage it must be needless for us to say that IT WILL DO.

ART. XVI.—GRAY'S SECOND EPISTLE TO THE CLUB.

DEAR ANCIENTS,—You will no doubt be agitated with considerable wonderment to find this letter written with keelyvine instead of with the superfine liquid blue with which I usually edify mankind. But you must know that I am not in the house just now, and cannot settle down to a regular chair and table during this fine weather so as to take the benefit of Christian inkbottles, and a sort of pagan one that I tried to carry out yesterday, capsized in my waistcoat pocket and destroyed all the buzzom of my shirt, forbye filing two sheets of superfine post paper I had in my breast pocket. So I resolved to put no more trust in inkbottles, but to use for the future, on the hill side, a well whited keelyvine.

This comes to you from the side of Lochnagar, as the Englishers call it, but Lachin y Gair is the right name, and therefore the name to be adopted by the ARTIZAN. In my last I told you I was going there, and I have been there every day sin syne. Oh! it is a glorious spot!—But if once I begin in this key I will be sure to fill my letter with flummery, as you Cocknified characters call it; so I'll leave all that to the hinder end. It is grand for filling up.

And here, while I mind it, I must tell you of a coincidence which befel me, Tuesday was a fortnight, which shows very conspicuously the high opinion enterteened here of me and the ARTIZAN. You must know that before I came down, the fame of the ARTIZAN had not reached the artizans of Braemar, and great was their delight and admiration when they came to know respecting it. Upon this they represented unto me that it must certainly be a fault in the conducting of the work that they did not know of it, and that there must surely have been no adverteezments in the papers. I told them that there had not been, and I believed was not to be any, because we did not want to puff or push the work, but to feel the pulse, as it were, of the working men, so that we might know who was who; for that all the clever and well-to-do persons would at once discover the cleverness of the work and take it in; whereas the stupid and riff-raff characters would not; whereby it would be made clear to all the world who it was that belonged to the one class and who to the other. It was, however, represented to me, in reply to this remark, that this might no doubt be a very fair way of judging when the work became known to the whole of such persons, but that it could not hold in those cases in which the ARTIZAN had not been heard of, and that according to that rule the artizans of Braemar would be convicted of gross ignorance and stupidity, whereas it was known very well they were quite the contrary. I saw very well there was much force in this objection, but I only said in answer to it, that if the artizans of Braemar thought proper to put down on a sheet of paper their sentiments anent the topic, I would forward it to the club to be there considered. A meeting was accordingly held that night, the blacksmith of Braemar in the chair, the wheelwright acting as secretary, when the following petition was drawn up, which I here transmit according to the promise I gave.

"To the Honourable the Conductors of the ARTIZAN in Club assembled,

"The Petition of the Artizans of Braemar,

"Humbly Sheweth,

"That your petitioners have within a very recent period become acquainted with the existence of the *Artizan:* a work which has called forth their admiration of the talent with which it is conducted, and their gratitude for the exercise of that talent in the service of the class to which they belong.

"That your petitioners feel that the whole class of artizans must derive infinite advantage from the publication in question, not merely in consequence of the technical information relative to their various occupations they will obtain from its pages, but on account of the altered sentiments with which all artizans must be regarded by the other sections of the community, in consequence of the new light in which they are made to appear, and the great talent and honesty with which their interests are represented.

"That your petitioners are assured that the mere circumstance of being a subscriber to the *Artizan*, will be universally accepted as a *primâ facie* evidence of the ability and good character of a workman so soon as the existence of the work becomes universally known, but that in a great number of the more remote and obscure localities the work has not yet been heard of.

"That it is unfair to the artizans of those localities to be condemned because they are not subscribers to a work of which they never heard, as well as injurious to them in other respects, by shutting them out from means of improvement of which they would have been glad to avail themselves, and which are not to be attained through any other channel.

"Your petitioners, therefore, pray that you will be pleased to adopt such measures, by advertisement or otherwise, as will make the work known to every artizan in the empire, so that every man may have the blessing of such a friend and instructor within his reach, and that should be reject the work, the sin and injury of that rejection may fall upon his own head. And your petitioners, as in duty bound, will ever pray, &c., &c."

There appears to me no small amount of reason in all this; but as I knew that it would meet with but small consideration from the club, and especially from Sir Jonah, who would be sure to say that he detested puffing; I have taken steps myself to have the wishes of the petitioners, in some degree complied with; and as it is now too late to contradict my directions, I will tell you what I have done. I have sent word to Messrs. Simpkin and Marshall to get sundry advertisements put into the newspapers, especially in those which go the rounds of the back nooks and crannies, so that every person may know that there is an *Artizan*. I do not approve myself of the plan of advertising and advertising, aye in the ae thing, as if you were determined to ding a maggazin down folks' throats, whether they wish to have it or not. No, no. I agree with Sir Jonah there. We should not ask or persuade people to take in the *Artizan;* for if, when they know of it they do not take it of their own accord, it is plain they are fools who do not know what 's good for them, and that they will never get on in life. We have no business to fash with such people as those, for mere circulation is not our aim. But we want to make the readers of the *Artizan* wiser and better: we want to put the readers of the *Artizan* on a higher elevation than those who are not readers of the *Artizan;* and to promote, ay and secure their success in their several callings. This we can do, and indeed stand in a measure pledged to effect; but it is enough to have to make the fortunes of those who are anxious that their fortunes should be made without pestering ourselves with a set of neer-do-weel blockheads, who are no more able to understand the benefits conferred by the *Artizan*, than the beasts that perish. Besides, although we may think nothing of the loss on twenty thoosan, the loss on sixty or eighty thoosan would be too much for ourselves to thole, and therefore should we endeavour to restrick the circulation of the work to the respectable and clever class of workmen; they being the only ones worth our while to spend our time and money upon, and that is precisely the class which will discover the benefits of the work for themselves, and take it in of their own accord. I hope Messrs. Simpkin and Marshall will understand this, and not put Sir Jonah in a bleeze, and the Club into great expence by shoving up the circulation to eighty or a hundred thousand by means of their bookmongering clap-traps; for we cannot, I should say, afford to print more than fifty thousand at the utmost, unless, indeed, we get assistance from the Institute. Nevertheless, it is right that decent people, in the hye places, should be put on the same footing as the decent people of the world's great thoroughfares, and therefore I have notified the "Lords of the Court" that they will be pleased to adverteeze the work more widely; not saying that it is a good work, or a bad work; for folk who cannot find that out themselves, we do not want—but merely saying that such a work exists.

But the shades of evening begin to close owre me, as the sang says, and warn me to desist. Yes, the shadows of the mountains have stretched across the valley, and hold the opposing hills in their embrace most lovingly. Here and there only the dying sunbeam is reflected from the surface of the Dee, which winds and winds from hill-side to hill-side, as if loath to leave the scenes of its nativity—just like myself when I first left this glorious valley to cast myself upon the waters of a stormy and relentless world. There, beneath that eminence on which the eagle has just settled, is the spot where Byron passed his childhood, and drew that inspiration from his communings, with the awful grandeur around him which raised his soul to heaven, and stamped his page with immortality. Hah! a kindred spirit comes upon me, weaker, fainter, and less glorious, but yet strong, vehement, and not to be resisted. Yes, yes, I obey—obey most willingly: here—here, I indite a stanza to

LACHIN Y GAIR.

I.

Away with the town and its dark cluster'd houses!
I'm sick of its toilsome, monotonous life;
I hate the wild laughter where folly carouses,
And turn in disgust from its dissonant strife.
Hurrah! through my own native glens I am roaming!
Hark! the pibroch complains to the spirits of air;
While daylight gives place to the pale hues of gloaming,
And above me frowns sullenly Lachin y Gair.

II.

Ah! well may this spot wake the chord of deep feelings,
For here were the days of my infancy pass'd;
And here first I drew love's enchanting revealings
From my own Highland Mary—my first love—my last.
And here too we parted—O hour dark with sorrow!
But youth has too sanguine a bosom for care;
From the gloom of to-day augurs bliss for to-morrow,
So I turned with a light heart from Lachin y Gair.

III.

With the wide world before me I walk'd on elated,
Though homeless and, ay, nearly penniless too;
For I fed on the hopes which my love had created,
And knew the grand secret—*To will is to do*.
So I swore in that hour, if that Providence spare me
With health and with strength, I will never despair;
And I toil'd late and early for sake of my Mary,
And soon sought my bride at dear Lachin y Gair.

IV.

Now Lachin y Gair, I am once more reposing
On thy heath-covered side, where I lay when a boy;
And the eyelids of life, as of day, are fast closing,
Yet my heart, young as ever, throbs wildly with joy.
Though many fond fancies of boyhood have perish'd,
Like the forms which now melt in the soft evening air;
Yet fondly through weal and through woe have I cherish'd
Remembrance of thee, my own Lachin y Gair.

There—there—I cannot see to write another word, so you must just take this as you find it, with all its imperfections. Tell me, when you have time, whether you think me or Byron is the best poet.

Your friend in the dusk,
A. GRAY.

Lachin y Gair,
Month of September, 1843.

ART. XVII.—FINCHAM ON THE MASTING OF SHIPS.

A Treatise on Masting Ships, and Mast-making, explaining their principles and practical operations, the mode of forming and combining made masts, &c. By JOHN FINCHAM, Master Shipwright of H.M. Dockyard, Chatham. Second edition. London: Whittaker, 1843.

WE welcome with much cordiality the re-issue of this valuable work in its present improved form. Of the estimation in which the first edition was held by naval architects, its rapid sale is probably the best criterion; and the present edition, in its amended form, can hardly be supposed to be less acceptable.

The authority of this work is not more dependent on the known scientific eminence and experimental knowledge of the author, than on the peculiar opportunities he enjoys of obtaining authentic and practical information touching the various points on which he treats,—sources of information which are sealed up to less favoured inquirers. Hence the "Practical Operations in Mast-making" are of corresponding excellence; and, indeed, since the publication of the first edition, the work has been a text-book for the mast-makers, as well of merchant as of the government establishments.

We doubt whether the theoretical topics which the subject comprehends might not have been much more fully developed than we here find them to be. But the approximations afterwards rendered necessary to realize a practical result, arising from "the present limited state of our knowledge of the effects of the combined agency of wind and water," has manifestly indisposed Mr. Fincham to enter upon such ground, as involving an unserviceable complication. In that view of the case, he is rather to be applauded than otherwise for confining his preliminary observations within practical limits; as any scientific disquisitions, although adding to the completeness of the theory, would have failed to improve the practice.

In the advertisement to the second edition, Mr. Fincham says,

> "The engagement made in the former edition, with regard to the masting of merchant vessels, has been fulfilled in the present; and several new methods have been described of combining made masts. There has likewise been given a description of the masting of steam vessels, with the proportions of the masts, yards, &c. There has also been added a plan for the systematic classification of masts, in which it is shown that a few systems of masts and yards would be sufficient for general use, so as to bring the power of the sail in a correct relation to the stability of the ship."

Here we are on entirely new ground, no feasible scheme having, to our knowledge, been hitherto matured for systematizing that in which all system is set at defiance, namely, the masting of the merchant ships of the present day. He appropriately remarks:—

> "In determining the masts for merchant ships, no general rule appears to have been observed, as we find many ships in the same trade, and of the same dimensions, with very different masts and yards; and which, from their form of general cargo, would appear to have about the same stability, and consequently require the same number of men to work them. This in some measure may be accounted for, by the masting of these ships being often left to be determined by the idea of the persons who are to sail them,—sometimes to the owner, and at other times to the builder."

By deriving rules from examples of the most approved rig, some valuable tables are computed.

On the subject of steamers the author observes:—

> "The masting of steam vessels is not subject to the same strict rules that are made to determine the masting of other classes of ships. The length of the masts and yards must, however, bear some general relation to the length and breadth of the vessel; but both this relation, and the positions of the masts, are subject to many variations depending on particular circumstances, especially on the service in which the vessel is to be employed, whether for long and short voyages, or only in rivers. The position of the masts must, in many cases, be determined by the situation of the machinery, and the quantity of sail be regulated by the requirements incident to its employment. It is, however, important, on account of the obstruction which the masts and yards present in steaming head to wind, that they should be made as compact as possible. Although it is desirable that the centre of effort should be kept as nearly as possible in a correct relation to the mean resultant of the water, when by the wind; yet, from the great length of these vessels in relation to their breadth, any small deviation from that is not felt; the limits within which these vessels will answer well being more extended than in other vessels."

No rule has hitherto been observed in proportioning or placing the masts of steamers; and in the absence of better data, we therefore think Mr. Fincham unwarranted in applying the same theoretic rules both to sailing and steam ships; neither do we quite agree with him in the dimensions he gives for the masts of steam vessels generally. The subject is one, however, so dependent upon adventitious circumstances, and so poor in authenticated facts, that we have no better reason for our dissent than Mr. Fincham has for our conformity. In cases where we can only indulge in conjecture, the wisest person will say the least; but every praise is due to him who favours the world with the results of his experience or observation, for every accession, however small, to our knowledge of facts, is an increase to our stock of knowledge.

We have always observed much inconsistency in the systems of classification of masts and yards which have come under our notice, and such systems appear at variance with the very principles on which the dimensions of these masts were fixed, and their positions determined. That there may be advantages, however, in a good system cannot be denied, and "it seems now desirable to introduce some systematic classification of the masts, yards, and sails of ships of war, by which the number of sizes required in the navy might be reduced to a minimum." But in doing this an opposite error is almost unavoidable, as in the system adopted at present "such classification and plan give no rules for fixing them in relation to the stability of the ship."

"In order to accomplish this, it is necessary that the amount of sail should bear some fixed relation to the stability of the ship, as ascertained by experience. A comparison of the stabilities of a number of ships, with their moments of sail, appears to be the most satisfactory way of ascertaining the extent to which the moment of sail may be carried, without exceeding the just limits fixed by the relative stability of the ship; whilst she may be masted up to her full power of carrying sail. This result may be insured when the masts and yards are determined in some relation to the stability." Upon this Mr. Fincham's plan is grounded, and certainly some of the objections to classification are thus partially removed, without losing its advantages.

There is throughout the book one great omission,—there are no rules for determining the stations of the masts, or exposition of the principles on which this important element is dependent. True it is that something of the sort is given in the table of "proportions in terms of known quantities;" but if these fractions are definite, and to be relied on, surely the same holds good for the dimensions, &c.; and therefore tables of position are as necessary as tables of dimension. Indeed, these latter might have been considerably abridged by the substitution of the sector and two of the extreme dimensions from which the tables have been formed.

The extensive and original experiments "on the relative strength and flexibility of mast timber," the conversion and practical operations in mast-making, and other parts of the work, need no comment or recommendation from us to increase the already well-established fame of this excellent and comprehensive treatise, valuable alike to the naval architect and mast-maker, and constituting a manual or assistant in the various branches of their respective trades. The work is also to be perused with profit by naval officers, so that they may earn an acquaintance with a subject of no mean importance —the propulsive efficacy of their sails.

ART. XVIII.—BAINES ON THE RELIGIOUS STATE OF THE MANUFACTURING DISTRICTS.

The Social, Educational, and Religious State of the Manufacturing Districts, &c., in Two Letters to Sir Robert Peel, Bart. By EDWARD BAINES, JUN. Simpkin, Marshall, and Co. 1843.

THESE letters were written with the design of showing forth the fallacies on which the Factory Education Bill, of the last session of Parliament, was founded. In the accomplishment of this, they certainly are eminently successful, partly by virtue of the clearness of their reasonings, but chiefly on account of their formidable array of facts. The accumulation of these facts must have been a work of infinite labour, and certainly Mr. Baines is entitled to the gratitude of all liberal, and indeed illiberal minds, for the great trouble he has so disinterestedly taken. We regret that our limits prevent us from giving any reasonable sample of the weighty information with which the work overflows. The following extracts, taken almost at random, may convey a faint impression of the style of the production.

> "Of the moral condition of the Manufacturing Districts a dreadful picture was drawn by Lord Ashley, in his speech on moving, 'That an humble Address be presented to her Majesty, praying that Her Majesty will be graciously pleased to take into her instant and serious consideration, the best means of diffusing the benefits and blessings of a moral and religious education amongst the working classes of her people.'"
>
> "But not only is the Report of the Children's Employment Commissioners to be regarded as *one-sided*, and presenting all the *shadows* in the picture without the lights,' Lord Ashley goes to that Report in the same spirit with which the Commissioners went into the country, or rather with a still more fixed purpose to discover *all that is bad*. He selects the strongest evidences he can find, in their three folio volumes, of ignorance and depravity, especially the records of crime; he brings all these together within the compass of a speech; and thus you have not only the *selected*, but also the *concentrated*, evil of populous districts laid before Parliament and the country,—without one caution thrown in, to prevent this double-distilled essence of evil reports from being taken as *a fair sample* of the condition of the whole manufacturing population!
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> "Nor is this all. Lord Ashley makes all his facts and extracts bear upon the *manufacturing* and *mining* districts *exclusively*. He says not one word about the state of the rural districts,—not one word about London, or Oxford, or any town or village of Dorsetshire. He points out the *manufacturing* districts alone as hot-beds of vice, impiety, and misery; he affectingly calls for sympathy with *their* perilous condition; and he represents it as a case of such urgent necessity, that if the Government and Parliament do not make haste and interpose, some dreadful convulsion may be expected."

ART. XIX.—PROMISCUOUS NOTES ON STEAM MACHINERY.

Facings of Cylinders.—WE have tried a great variety of metals for facing cylinders, but, after all, are inclined to give the preference to brass, with which we began. Many engineers employ brass valves now. Boulton and Watt, for example; Miller and Ravenhill, and others: and these, certainly, are good authority. But, in adopting a brass valve, it is almost necessary to have a cast-iron face for the cylinder; and if there must be cast-iron, we should rather have it on the valve face; and for this reason:—As soon as the valve face wears untrue,—and that is a contingency to be looked for,—the steam will pass as a matter of course, and, in passing, will make the surface of the cast-iron rough and granular; while on the brass, it will exercise comparatively little effect. If this roughness be on the valve face, it is easily remedied, for the valve is easily drawn: but if it be on the cylinder face, it is not to be remedied without taking off the valve casing. We have tried brass working against brass, brass against steel, and numerous other combinations, but have found brass and cast-iron work more satisfactorily than any other. And, with such a combination, we prefer to have an iron face on the valve, and a brass face to the cylinder, for the reasons we have mentioned.

Expansion Valves are mostly of the double-beat or Cornish kind. Of this plan we do not approve. With the quick opening and shutting to which, in a steam-vessel, a valve of this kind is necessarily subjected, it becomes very noisy, and it is difficult to keep it tight. Another plan of expansion-valve consists in the application of a sliding-plate between the D valve and cylinder face. This was the kind of valve introduced in the "Berenice," and we understand it operated well. There are several other examples of this kind of valve which have come under our notice, which have all answered well; nevertheless, we prefer a slide on the side of the casing, such as is used by Boulton and Watt. It is an uncommonly simple kind of expansion-valve: makes no noise, and has very little tendency to become leaky.

ART. XX.—THE WATER SUPPLY OF LONDON.

THE importance of an ample supply of good water, especially in large towns, is sufficiently appreciated by all classes, without requiring to be enforced by any remarks of ours. If the importance of having pure, drinkable water, can be greater at one time than another, it is at the present, when large bodies of the people are abstaining conscientiously from intoxicating liquors, and when the more temperate habits of society have increased the demand for water as a beverage. But, whilst the necessity is admitted, the means adopted to supply it, in the metropolis more especially, have been sadly inadequate; and, without joining the outcry raised a few years since by some interested parties, against the "poisonous" qualities of the water served by many of the companies, we must protest against the fitness of liquid so contaminated with animal, vegetable, and mineral matter, for the drink of the people; and if better water is to be obtained, means should be taken to procure it.

During the investigation conducted by the authority of Parliament, in 1834, into the supply of water to the metropolis, the evidence of the witnesses was most conflicting; some of them asserting that the specimens of Thames water submitted for examination were highly deleterious to health; whilst others, from analysis, pronounced that they contained nothing whatever that could be considered injurious. Among the latter class of witnesses was Dr. Bostock; who states that the water taken from the Thames, which he had analysed, contained, in ten thousand grains, only two grains of solid matter; and the water taken from the river immediately opposite the West India Docks was found to contain scarcely three grains of solid matter in ten thousand. It was further asserted, by the advocates of the Thames water companies, that though the impurities the water contained might render it disagreeable to the taste, they were by no means injurious to health. Now, admitting these statements and opinions to be correct, and that the Thames water does not contain any unwholesome impurities, we should still contend that *unpalatable* water is not fit to be offered as a general beverage; and it seems not to be denied that the Thames water is, comparatively at least, unpalatable. Even were it as pellucid as a mountain spring, the well known fact, that the Thames is the general reservoir for all the sewers of London, and that some of the water companies take their supplies from the river after it has received most of those drainings, is sufficient to excite disgust, and to make the water-drinker turn sickened from the draught. Chemical analysis may prove that the impurities do not occupy one five-thousandth part of the whole; and that the solid matter consists merely of carbon, or nitrogen, or oxygen, which, in other combinations, are essential to animal life; nevertheless, the people are not yet philosophers enough to relish the contents of a sewer, though chemistry assures them it contains the same elements that compose their choicest food.

The same objection to which the water of the Thames is liable may be urged, though in a minor degree, against the other sources from which London is supplied. The New River is filled, principally, from springs of pure water arising from the drainage of the chalk at Chadwell and Amwell, in Hertfordshire; and had it been conveyed to London in a covered conduit, nothing further could have been desired. The water is, however, somewhat deteriorated by an addition to it from the river Lea, at Hertford, as the original sources were not found to be sufficient for the extended operations of the company. To this accession from the river there would not have been much objection, had the pollution of the water been avoided by covering it in; but through the whole of its sinuous course, extending for thirty-eight miles the New River is exposed to contamination of every kind, short of being made a common sewer; and, during the summer months, it is the general bath for thousands of the inhabitants of the country through which it meanders. It may, therefore, be questioned, whether the contaminations to which the water of the New River is exposed are not quite equal to those of the Thames, when the relative volumes of the two streams are considered. And it must be borne in mind, that by far the greater part of the filth emptied into the

Thames is continually carried away to the sea, whilst *all* the impurities of the New River form a component part of the water which is drunk.

Some of the water companies which draw their supplies from the Thames have made arrangements for filtering it before it enters the service pipes. By this means, if effectually pursued, the water may be considerably purified from all foreign matters suspended in the fluid, but no process of filtration can separate the matters with which it is chemically combined; and even after river water has undergone every possible purification by mechanical means, it can bear no comparison to pure spring water as a beverage. Spring-water, it is true, may contain more solid matter than is to be found in water from clear rivers, but it is questionable whether the lime which makes it *hard*, is not actually conducive to health; and there can be no doubt that the carbonic acid with which spring water is impregnated, gives it a pleasant brisk taste, compared with which the water of the clearest rivers seems vapid.

The means of supplying London with water has occupied the attention of the citizens from early periods of its history; and with the extension of the town, the problem, how to provide an abundant supply of pure water, has become of more and more difficult solution. In former times the bournes and brooks, and springs which abound in the neighbourhood of the city afforded a sufficient supply. Old-bourn (Holborn), Tich-bourn, and Tyebourn, Wall-brook, and Fleet-river, formed some of the running streams whence pure water was derived; and when Clerks'-well (Clerkenwell), Holywell, and Spring-gardens, were rural retreats, there was no deficiency of water. As houses covered the fields the rivulets became drains; the wells proved insufficient, and more distant sources were sought whence water could be drawn; until the Thames itself was put in requisition, and the waterworks at London-bridge were erected for the purpose of carrying it into the houses through wooden pipes. The Hampstead springs had, in the meantime, been rendered available, and many reservoirs were formed for the collection of the water at elevations, from which it could be conducted to supply the northern parts of the city. The still increasing wants of the inhabitants originated many projects for conducting to the metropolis some one of the rivers that take their rise in the chalk hills of Hertfordshire; and at length, after many difficulties, the New River was completed at the beginning of the 17th century, by individual enterprise. Sir Hugh Middleton commenced the work with his own resources alone, after it had been abandoned by the corporation of London; and his funds having become exhausted when it was half completed, from King James he obtained the pecuniary means which the corporation refused, for the completion of the work. As an individual undertaking, the New River probably exceeds in magnitude and public utility any on record. The quantity of water it was originally calculated to supply may be estimated at ten millions of gallons per day. Since the addition of water from the Lea it supplies now nearly double that quantity, and the demands upon it are daily increasing.

According to the returns presented to Parliament in 1834, the following were the quantities supplied daily by the different water companies of London:

		No. of Houses.	Gals. supplied daily to each House.
New River Water Company		73,212	241
Chelsea	ditto	13,891	168
Grand Junction	ditto	11,140	185
East London	ditto	46,421	120
South London	ditto	12,046	100
Lambeth	ditto	16,682	124
Southwark	ditto	7,100	156

If we assume the increase in the consumption of water during the last nine years to be equal to that of the previous corresponding period, the New River alone must now supply 20,000,000 gallons daily, and the other water companies about 24,000,000, which will make the total daily consumption of the metropolis, including Southwark, amount to 44,000,000 gallons per day.

It will be observed, on reference to the article in our last number on the Croton aqueduct for supplying New York, that the average quantity of water conveyed by it exceeds the consumption of London; and that that single conduit is calculated to be more efficient than the whole of the London waterworks united in the amount served, whilst the quality of the water is far superior, as it is conveyed in a covered culvert, from the rocky channel of the river, removed far from animal contamination. It is a curious coincidence that this great undertaking for supplying with water the first city of the United States, should be, within the fraction of a mile, the same length as the chief conduit for supplying London; the Croton aqueduct being thirty-eight miles long, and the New River thirty-eight miles and three quarters. The cost of construction of the New River is not accurately known, as all the original papers connected with it were destroyed by fire; but the expense is supposed to have been nearly the same as that of the Croton aqueduct, which cost about 1,800,000*l*. The volume of water in the New River far exceeds the capacity of the Croton aqueduct; but the great width and depth of the river was requisite in consequence of the close approximation of the levels of the New River Head and of the springs where the water is derived. The fall of the New River does not exceed on an average three inches per mile, therefore it has not a fall of ten feet during its whole course of nearly thirty-nine miles. The fall of the Croton aqueduct exceeds twelve inches the mile. The average width of the New River is eighteen feet; its depth seldom exceeds five feet in the middle, and as the bottom rises towards the banks on each side, we believe we shall not be far wrong in estimating its contents to be equal to those of a rectangular tank ten feet wide by five deep. The contents of each foot in length of such a tank would be equal to fifty cubic feet; and if the whole stream were to move at the rate of a half a mile an hour, the quantity of water discharged into the reservoir in twenty-four hours would be about twenty-six millions of gallons, which is not much more than the actual quantity discharged daily from the same pipes. Taking the same estimate of the average capacity of the New River conduit, the whole mass of water it contains, from its source in Hertfordshire to the reservoir at Pentonville, may be calculated to amount to eighty-four millions of gallons, or about two days' supply for the whole of London.

The bottom of the New River is in many places composed of thick mud, nevertheless were it to be all covered in, so as to avoid the agitation consequent on exposure, and the pollution from vegetable and animal matters, there is little doubt that, with so slow a movement of the water, the mud would be undisturbed, and the stream would be delivered in London in nearly its pristine purity. Were this effected, the water of the New River would indeed be a boon to the water-drinkers of the metropolis, such as its public-spirited projector intended it should become; but in its present muddy, contaminated state, it cannot be drunk without some feeling of disgust, however purified by filtration. The New River alone would not, however, more than half supply the demands of London, and the company have a main nearly three feet in diameter in the worst part of the river Thames to draw from thence an additional supply in cases of exigency. How often those exigencies may arise, the public cannot tell, and if the demands on the New River should multiply the main in the Thames must furnish the supply.

It is from the Thames that all the other water companies, with the exception of the East London, fill their reservoirs; and though some draw their supplies from parts of the river less objectionable than others, and subject it to a process of filtration; yet from no part of a navigable river like the Thames, flowing through a densely populated country and lined with towns and villages, can water fit to drink be obtained. We are forced, therefore, to the conclusion that even were the New River and the East London Companies to do all in their power to prevent the pollution of the water, so as to render it pure and palateable, there would still be wanting fresh sources to furnish the necessary quantity. Of the many plans that have been propounded at various times the most favourite one appears to be that of conducting to London some of the rivers that rise from the chalk hills of Hertfordshire; but the objections to such a project are the expense and the uncertainty of supply, and after all, the water derived from such a source would be liable to pollution in flowing for some miles through an agricultural country. To obviate the latter objection, and with the view of obtaining an abundant supply of the purest water, it was proposed a few years since to sink wells into the chalk formation below the level of the valley of the Colne, from which it was expected that at least 8,000,000 gallons a day might be raised, to which quantity, the proposed London, Westminster, and Metropolitan Water Company limited their views. Much opposition was made to the project, as there always is to any plan likely to interfere with established interests, and the undertaking was at length abandoned. The main question arose on the probability of procuring an adequate supply, and on the probable injury likely to be occasioned to the wells in the neighbourhood. Many opinions, from men more or less capable of forming a correct judgment on the subject were published at the time, the most important of which were the reports of Mr. Robert Stephenson to the proposed company. The extensive experience he had of the chalk formation in cutting through it during the works of the Birmingham railway gave a practical value to his opinions, which none of the others possessed. Mr. Stephenson endeavoured to establish the following positions:—

"1st. That the chalk is the great water-bearing stratum, underlying the London clay.

"2nd. That below the level of its natural drainage of the country, it is charged with an enormous quantity of water which may be obtained with extraordinary facility by pumping.

"3rd. That the quantity obtainable from shafts is amply sufficient to meet the object contemplated by the Company."

Mr. Stephenson noticed that in sinking wells in the chalk district between Watford and Tring, the subterranean reservoir of water seemed always conformable to the natural surface of the country; and that whilst at Watford it was necessary to sink below the level of the Colne to obtain water, yet higher up the valley towards Tring "water is procured at levels corresponding strikingly with the inclination of the valley, far above the levels of the water in the wells at Watford."

Mr. Stephenson also mentions, as a remarkable fact, and one which shows the great abundance of water in the chalk and its power to absorb moisture and retain it far above the surrounding levels, that in the Tring cutting, near the summit of the chalk ridge, a quantity of water was met with which yielded upwards of one million gallons per day, and which still continues to yield it without any sensible diminution.

Previously to commencing the Tring cutting, attempts were made to sink wells to test the material from the surface of the land to the intended depth of the cutting; but so freely did the water flow from the chalk that it was found impossible to sink several of them by ordinary means to the depth of sixty feet. "Similar results," he observes, "have followed all experiments of this kind which I have witnessed; and those who are best acquainted with the sinking of wells, through districts occupied by the chalk formation concur in the opinion, that it should be regarded as as enormous mass of rock saturated with water, which it yields with the utmost rapidity by the action of a very small hydrostatic pressure." We confess we are at a loss to reconcile the fact that the chalk continues saturated with water at elevated points with the opinion that "it yields it *with the utmost rapidity* to a very small hydrostatic pressure." The fact, however, seems to be well established, that chalk possesses great absorbing power, and that the water is retained between its interstices by capillary attraction, or other force, at a considerably higher level than that of the surrounding water. It appears also evident, that when the sustaining connexion between the saturated chalk above and that below is cut off, the water runs out in the same manner as a sponge, which will remain saturated with water whilst it touches the surface; but when lifted above it a portion of the water runs off. In the case of chalk, however, the opposition offered to the percolation of the water between the minute interstices prevents a very rapid drainage, nor will the drainage take place laterally without considerable pressure.

As partial instances of the chalk formation affording abundance of water, Mr. Stephenson mentions a number of large towns which draw their supply either chiefly or entirely from wells sunk into the chalk. The most important of these is Brighton. The surface of the well is sixty-four feet above high water mark, and it is sunk to the depth of ninety-seven feet. At sixteen feet above the bottom, there are four adits driven in from the sides of the well, to the extent of forty-six feet each, and about six feet square. The water in this well stands at very different heights at different seasons of the year. It is sometimes as low as fifty-eight feet from the surface, and sometimes it rises to within nine feet of the top. The pumps lift 230,000 gallons in twelve hours, and after constant working for that time, the level of the water is reduced about two feet, but it speedily regains its former level when the pumps cease working.

It appears, from the numerous facts stated by Mr. Stephenson, that large quantities of water are to be obtained from wells sunk into the chalk, but that it is not yielded very rapidly from the rock; for it is found necessary, in many cases, as at Brighton, to drive adits into the sides of the wells, to increase the drainage surface. It must be borne in mind, however, that though the water may sink two feet or more after the first twelve hours' pumping, it would not continue to fall at that rate; for, as the level of the fluid in the well became reduced, the hydrostatic pressure of the water in the saturated chalk would be increased, and it would be yielded more abundantly.

From the facts adduced, we have no doubt that by sinking wells into the chalk, near Watford, as originally proposed, and by driving adits for the collection of the water, that a supply to the quantity required might be obtained; but it seems to follow, almost as a necessary consequence of the principle of drainage contended for by Mr. Stephenson, that the deeper wells must tend to drain those in the neighbourhood that are less deep, and that the lower they are sunk the more extended will be their draining influence. It appears, indeed, tolerably evident that the water in the chalk formation, at the depths to which the wells alluded to have been sunk, is percolating through the rock towards some subterranean reservoir, and that the wells merely collect the water in its progress. It would become, therefore, an important consideration, in determining the manner in which the metropolis could be best supplied with water from the chalk formation, whether it would be better to collect the water in wells on the upper levels, at a distance of twenty miles, and bring it, in a covered culvert, to an elevated reservoir, or to sink wells through the superincumbent strata into the chalk lying immediately under London. The former plan, which was contemplated by the London, Westminster, and Metropolitan Water Company, would require a number of wells, of the depth of about sixty feet, to be sunk at considerable distances apart, whence the water must be pumped by steam engines into the head reservoir. The expense of forming the culvert, the degree of uncertainty respecting the supply of water to be obtained, and the fear of local injury by draining the other wells in the neighbourhood, operated, a few years since, as insurmountable obstacles to the establishment of that plan; and we see no present prospect of those objections being removed. We turn, then, to the second method of procuring water by sinking wells in London or the neighbourhood; and shall briefly consider the possibility and practicability of obtaining, by that means, a sufficient supply.

Geological science and practical experience prove that the greater part of the rain which falls on the surface of sandy or chalky soils is absorbed, and that it descends until it meets with an impervious stratum of clay or rock, to stop its further descent. In an article on Artesian Wells, in the August Number of The Artizan, we explained the manner in which the subterranean reservoirs are raised above the levels of valleys, and force out the water when bored into; but we believe the instances are very rare, in this country at least, of Artesian wells being successfully bored into the stratum of chalk. This may be accounted for by the thickness of the chalk formation; for the lower part, which rests on impervious blue clay, lies so deep, that the immense basin of chalk is sufficient to hold all the water, without forcing it to rise above the level of the other strata. There can be little question, however, that the greater part of the rain which falls on the extended area where the chalk rises to the surface for many miles, is collected beneath in immense quantities, and is saturating the chalk under pressure. To give some notion of the quantity of water to be collected by drainage, we may state, that assuming the depth of rain that falls annually to be the low average of 24 inches, each acre would yield 500,000 gallons; and the drainage of the county of Hertford alone would afford water to supply the demands of twice the whole population of Great Britain. We may, therefore, safely conclude that the chalk formation under London, which receives the drainage of many extensive counties, is capable of supplying far greater quantities of water than can be required for the use of its inhabitants.

The depth to which it would be necessary to penetrate in order to procure a never-failing supply, may be ascertained with tolerable accuracy, from the results of experience. The chalk is reached at a depth of 280 feet below the level of the river; but to insure an abundant supply, it would be necessary to sink 100 feet into the chalk, and to drive adits to some distance, in various directions, to collect the water. A well was sunk for a brewery at Chelsea, to a depth of 394 feet, in which the water rose to a height of 200 feet from the bottom; from which it might be assumed that the standing reservoir in the chalk had been reached, and that the water was under pressure. At Mortlake, in Surrey, an Artesian well was bored 375 feet, 80 feet of which was also through chalk, when the boring tool fell into a mass of soft calcareous earth, and the water then rose gradually to the surface. Now, if the standing level of the water, in the chalk formation, be reached at those depths under London, there can be no question about the supply, and one large well should be sufficient. The next consideration would be, the means of raising the requisite quantities of water from the wells. Twenty millions of gallons per diem, for the supply of half the consumption of London, is four times the quantity of water raised from any one of the mines in Cornwall by their large pumping engines; but the depth of the latter is so much greater duty, that the amount of *engine duty* would not exceed that of the Consolidated Mines. One of the eleven pumps attached to the Mammoth engine now constructing in Cornwall, for the purpose of draining the lake of Haarlem, would deliver twice the quantity of water required to be lifted; therefore the amount of engine power to lift twenty millions of gallons from a depth of 300 feet, need not be a serious obstacle to such a plan.

The importance of the object to be attained should never be lost sight of; and when it is considered that the enterprising capitalists of New York House expended 2,500,000*l.* in distributing a supply of pure, drinkable water through that city, from a distance of thirty-eight miles, the inhabitants of London ought not to rest satisfied with the muddy, and almost loathsome, liquid with which they are at present furnished by the water companies, whilst an exhaustless reservoir of the purest water lies under their feet.

ART. XXI.—THE SOCIETIES.

The French Academy of Sciences.—There has been little of note brought before the Academy during the past month, much of the time of the learned academicians having been wasted in angry disputations between M. Libri and M. Lionville, which occupied the greater part of two sittings. Party feeling and petty jealousies engross too much the attention of the Academy at all times; and M. Arago, who is at the head of the strongest party, does not bear his honours with sufficient meekness to reconcile his opponents. The head of the opposite faction is M. Libri, between whom and M. Arago strong animosity exists; and the recent quarrel, though M. Lionville was the opponent immediately encountered, was considered a kind of faction fight. The origin of the dispute was a claim put in by M. Libri to be the original demonstrator of a difficult mathematical proposition, which had been vaguely announced without demonstration by M. Gauss. The validity of the claim was immediately denied by M. Lionville, who violently attacked his learned colleague, and asserted that all his pretended demonstrations were false. It is grievous to see the Institute, which is in most respects conducted on sound principles, thus converted into an arena for merely personal disputes, carried on in terms disreputable to the professors of science.

ART. XXII.—INVENTIONS OF THE MONTH.

A Steam Plough.—The project of ploughing by steam has been often attempted, though hitherto without success. A new apparatus of the kind has, however, been constructed in Scotland by Mr. Curtis, and put in action on Locbar Moss, near Dumfries, with much promise of success. The ground was very soft; nevertheless the heavy machine moved along easily, without sinking into the soil, which was considered a good test of its capabilities; but probably stubborn ground and unyielding inequalities would be a more severe trial of its power.

Electro-Magnetic Locomotive.—M. Wagner, who has been experimenting for many years on electro-magnetic power, and who some time ago was said to have completed an electro-magnetic locomotive that would be a perfect superseder to steam, is reported to have just constructed a more perfect engine, which will *really* accomplish all that is desired. The Germanic Diet having laudably offered a reward of 400,000 florins for the construction of an engine that would be superior for all practical purposes to steam-engines, it is said that a committee is about to be appointed to try M. Wagner's locomotive on the Taunus railway, and to determine whether it fulfils the requisite conditions.

Wearing Music.—The French often invent strange things, or at least are said to invent them; for not many of the wonderful things we hear of come in a tangible form across the channel. Among the latest curiosities of invention we find it recorded in a Lyons' paper that a M. Marlaveau, a silk manufacturer of that city, has applied the principle of the Jacquard loom to musical instruments, so that tunes can be varied by means of a pattern-card, in the same manner as the patterns on a silk gown. We have frequent opportunities in London of observing the grinding of music on barrel-organs, but the notion of weaving sweet sounds according to pattern in a Jacquard loom is surely something new under the sun.

Porcelain Railroads.—Another invention, said to have been perfected by our neighbours across the channel, is the formation of a substitute for iron as rails on railroads. The plan is nothing less than to mix porcelain clay, known by its Chinese name of Kaoline, with a mineral substance, and thus make railways of china. If this plan be adopted, it will necessitate a change in the foreign nomenclature, as well as in the practical construction of railroads, and the expressive term *chemin de fer* must give place to *chemin de porcelain.*

Water-jet Propellers.—A curious mode of propelling steam ships has been invented by Mr. Ruthven, of Edinburgh, who proposes to give a better direction to the propelling power by forcing jets of water through nozzles placed below the water-line. One curious feature of the invention is, that it contemplates employing the head-wave, which is now one great obstacle to the progress of vessels through water as a means of propulsion. To effect this, the water heaped up at the bow is to be admitted into two large orifices, which are to conduct it to a hollow axle; thence it is to be driven by the "centrifugal force" of revolving wheels to the peripheries, and forced through the jet-pipes into the water, the reaction of which it is expected will be a more effective and useful propeller than either paddle-wheels or screw. The plan is as yet only in model; and without wishing to prejudice the jet principle of propulsion, we must observe, that the notion of diminishing the resistance of the head-wave, by admitting the water to pass through orifices, is but little in advance of the Portuguese scheme for raising a car in the air by fixing a magnet at the top. We must add to that, the scheme is not a new one: it has been often tried, and always without success.

Ships Propelled by Waves.—Several plans have at different times been proposed for applying the motion of the waves as a motive power for machinery on land, but it is now attempted to apply their oscillating motion to propel vessels floating on them. The inventor is a Mr. Etzler, and his plan is founded on the known fact that the motion of waves is limited only to the surface. The object to be accomplished is to obtain, by means of a horizontal plane immersed in the calm water below, a resistance to the perpendicular motions of the ship, and to apply the resisting force to move machinery by which the ship may be propelled. This is to be effected by rods rising perpendicularly from each end of the submerged platform on both sides of the vessel, and to these rods are to be attached ratchet-arms, acting on toothed wheels. When the head of the vessel is lifted by a wave, the ratchet-arm would turn the wheel, as the distance between the motionless platform and the moving ship would be increased; and when the aft part of the vessel was raised a similar action would be communicated by the rods connected with that part. By these alternating motions the ship is intended to act as the beam of a steam-engine, and to move the paddle-wheels or other apparatus by which it is to be propelled. The inventor expects to obtain by this means a speed of twenty or thirty miles an hour; and the rougher the sea the faster the ship will move. It is needless to say, that a great moveable platform, suspended beneath the ship, would be fatal in a sea way, for one among other reasons, because it would prevent the ship from rising to the sea, so that she would necessarily be swamped. The scheme altogether is beneath contempt.

ART XXIII.—ANALYSIS OF BOOKS.

De l'Art en Allemagne, par HIPPOLYTE FORTOUL.

THE preface to these two goodly volumes informs the reader, that at the moment when Madame de Stael published her celebrated work on Germany, a movement was felt among the young artists of that country, which led to results that did not appear to the world until after the death of that illustrious woman; so that the work which initiated Frenchmen into the philosophy and literature of the Germans, could not afford them any information respecting the revolution which they have effected in the Fine Arts. This gap the author purposes to fill, by giving an account, compiled from letters written during his sojourn in Germany, as well of the modern works in German art, as of the ancient monuments on which they are modelled. M. Fortoul is faithful and exact, and on this ground his book would deserve praise; but he has properties of mind more high: learning—and we may observe, that a Frenchman is either learned or unlearned, never half learned—taste, enthusiasm, and as little of the cockneyism which passes current for nationality, as, in one of his country, can well be imagined. He is familiar with German literature; has coquetted—could a Frenchman go further?—with German philosophy; is thoroughly acquainted with German history; admires passionately German art, which he regards as the product of all these, and yet he remains a Frenchman, unmistakedly a Frenchman. One of his countrymen is reported to have shown, at great length, and with gravity imperturbable, how the Torquato Tasso of Goethe, if it had but been written in the French language, according to French rules, and in conformity with French human nature, which differs from human nature in general, must, inevitably and unimpeachably, have proved a grand and sublime poem. Somewhat in this fashion does every Frenchman think: should he exhibit symptoms of pure cosmopolitanism, he may be set down as dishonest—and in this fashion does our author think.

M. Fortoul visits Düsseldorff, Dresden, Stutgart, Weimar, Frankfort, Berlin, and indeed every place in Germany that has of late exhibited signs of artistic life, and notices each eloquently, eruditely, and benevolently, but briefly; to Munich, however, he devotes five-sixths of his book. The other towns of Germany are described in a similar manner; the architecture, as the primal element and germ, first,—the other arts of design, afterwards. In the architecture principally, he finds the real character of modern art in Germany; it is, he says, "essentially historical. Erudition is one of the principal characteristics of this nation; born in the universities of Italy, it was brought into France by the Scaligers; but, since the 19th century, it has found the most patient intelligences in Germany; there has it established its principal seat. It is erudition, combined with Catholicism, that has produced all the monuments which men are now raising up at Munich." The meaning of this is thus explained:—"In France it is generally agreed that art consists principally in invention; but this great principle, which often encourages ignorance, is not a preventive of monotony, nor of bad taste. In Bavaria art is practised, as if men had made up their minds that it resided in the memory;" thus then, modern German art, so much talked of, so much vaunted, is but servile imitation, an exact repetition of all the same forms which the genius of man has invented; this we doubt, though the author endeavours to prove it, by marshalling a vast array of learning, and expending no small eloquence, in some passages of a high order, on the argument. The moral which he draws is in the shape of prophecy:—"but in displaying more knowledge than genius, the architects of this country furnish a curious field for the studies of criticism, and prepare, perhaps, a new epoch, in which, according to the ordinary law, and with the reservations prescribed by the character of each people, the transfigured forms of anterior epochs will be found together." Unless this mean, that, when French artists shall have as much knowledge as genius, something very wonderful will follow, we really do not know what it means.

When we consider this work as a whole; the faithworthiness of the narrative, the general soundness of the criticism, the great learning that is brought to bear on particular subjects, the valuable hints which it suggests to the student, especially to the student of history; the uprightness of the author's mind, and the tendency of its very defect,—obvious and self-exposed—to further the exposition of truth, we hesitate not to pronounce it one of the most valuable contributions to the history of art, that has appeared in any language.

ART. XXIV.—MARVELS OF THE DAY.

Mr. Armstrong's Hydro-Electric Machine.—MR. ARMSTRONG has fitted up a high-pressure boiler, for the purpose of exhibiting the phenomena of the development of electricity by effluent steam, which was discovered by him and by Mr. Pattison. The apparatus, as it is now exhibited at the Polytechnic Institution, consists of a cylindrical boiler, made of rolled iron plate, 3 ft. 6 in. diameter by 6 ft. 6 inches long, without the smoke chamber, which is one foot additional. The furnace is within the boiler, and heated air is conveyed through the water in tubular flues to the smoke chamber to which the chimney is attached. The boiler is supported, at a height of three feet from the ground, by strong pillars of green glass, and the steam is discharged through forty-six jets, to which it is conducted by iron pipes, for the purpose of producing a partial condensation of the steam into water to be blown out with the steam, as that is supposed to add to the effect. The jets are each one-eighth of an inch in diameter, and they are made of partridge wood, from the notion that the friction of the water and steam is the exciting cause of the electricity developed. The steam is raised to a pressure of 75lbs. to the square inch before it escapes through the jets, and it is received on a number of metallic points in connexion with the earth. The electrical effects of this apparatus are most powerful, and far surpass those of the gigantic plane machine which was recently exhibited as one of the wonders of the Polytechnic Institution. The sparks obtained are 20 inches long, and a large Leyden jar is charged about four times as rapidly by the issuing steam as by the large plate machine. The rationale of the excitement of electricity by effluent high-pressure steam was greatly misunderstood by Mr. Armstrong and by the French philosophers when the phenomenon was discovered; nor does it appear to be freed from mystification at present. Mr. Armstrong at first conceived that the cause was attributable to the quality of the water, as the steam from one locomotive boiler exhibited electricity, and that from another did not; but it was soon ascertained that the difference was caused by the forms of the apertures whence the steam escaped. The philosophers of the French academy, however, discarding the subsequent experience, insisted that the assumed saline particles in the water produced the electricity. Dr. Faraday has recently ascribed the cause to friction of the hot water against the sides of the jet-pipe. Dr. Faraday is good authority on the subject, otherwise his opinion would be laughed at; and the phenomenon seems to be so readily and simply explainable by the different capacities of water and steam for electricity, and all the experiments performed by Mr. Pattison in 1840, so fully confirmed that view of the subject, that to seek for any other cause seems to be deserting the plain track merely to seek a more devious one in the regions of fancy. In the original experiments the issuing steam was condensed in insulated conductors from which the electricity was drawn; in the new arrangement the electricity is obtained from the boiler. We do not at present see that this mode of developing electricity can be applied to any useful purpose; for the electricity thus developed, though in a high state of tension, is actually much less in quantity than can be excited by the chemical action of a pair of the smallest zinc and copper plates. Every new development of power has, however, some beneficial tendency; and though at first it may appear to be useless, subsequent discoveries may render it applicable to important purposes.

Carson's Instrument for Curing Meat.—This instrument is a species of syringe, or small force pump for salting meat under the most adverse circumstances, and in a few minutes time by forcing the brine into its pores. The plunger of the pump is very small—not of much larger diameter than a black lead pencil, and around the barrel, in which the plunger works, a cylindrical reservoir is situated for containing the brine. Into this reservoir the brine is poured, and a few strokes of the pump sends it from thence into the meat.

There are three great advantages afforded by the use of this instrument. 1st. The meat is very effectually cured, as the pressure forces the brine into the minutest pores. 2nd. The operation of curing is effected in a few minutes, instead of occupying days or weeks; and, 3rd. The curing must be successful under the most adverse circumstances. We hear thrifty housewives lament, that in hot weather meat will not take salt, but with this instrument it has no option: it *must* take it, for the pressure overcomes all opposition.

It is obvious, that, by the use of this instrument the meat may be impregnated with a variety of flavours, besides that of salt. Thus, by the injection of a suitable liquid, we might have smoked Yorkshire hams made in five minutes, or any other flavour imparted to the meat, which is due to the absorption of an adventitious material. Altogether, the instrument is a most sensible and useful one, and must, when known, come into very extensive use. The great wonder is, that a contrivance so effectual, and so simple was not brought into use centuries ago.

OBLIQUE ARCHES.
Nº 1.

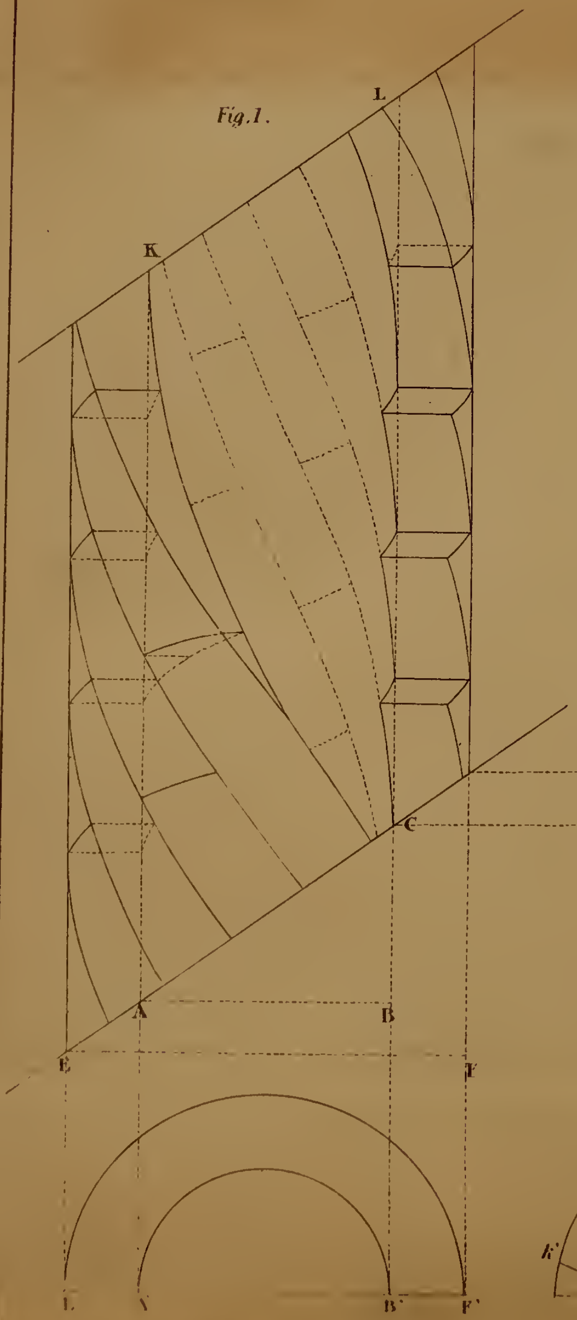

Fig. 1.

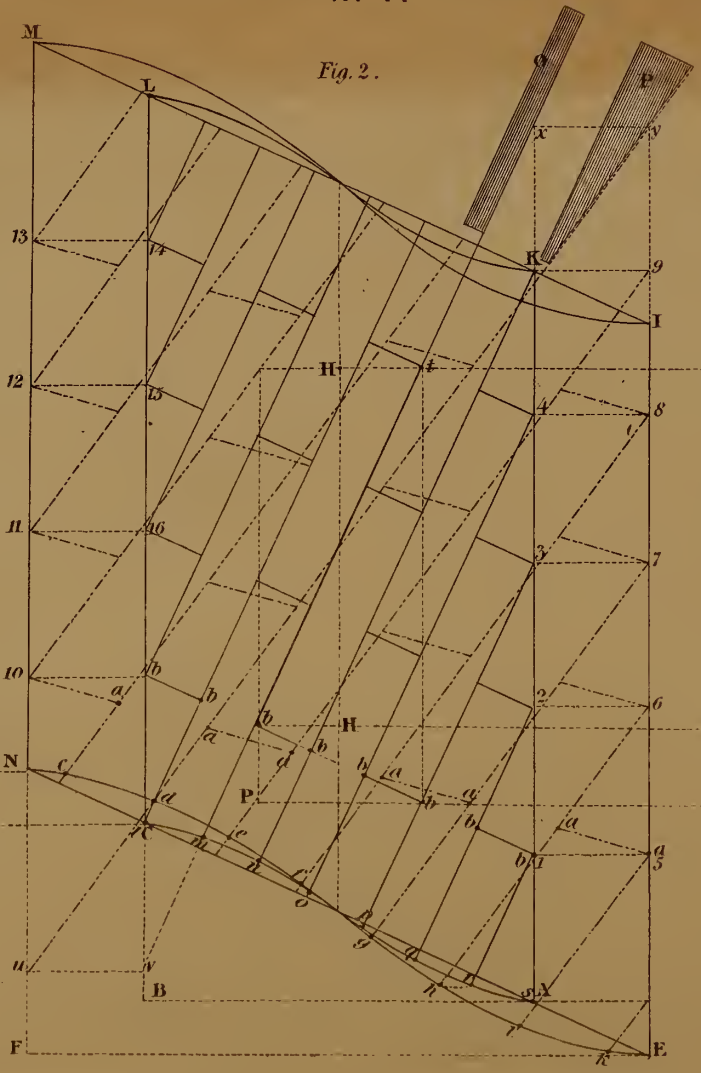

Fig. 2.

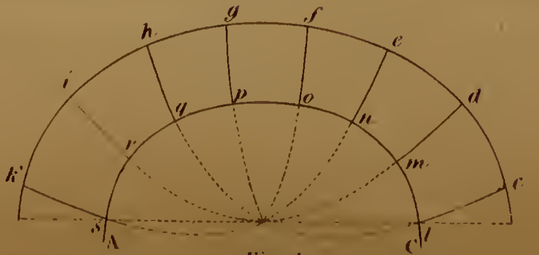

Fig. 1.

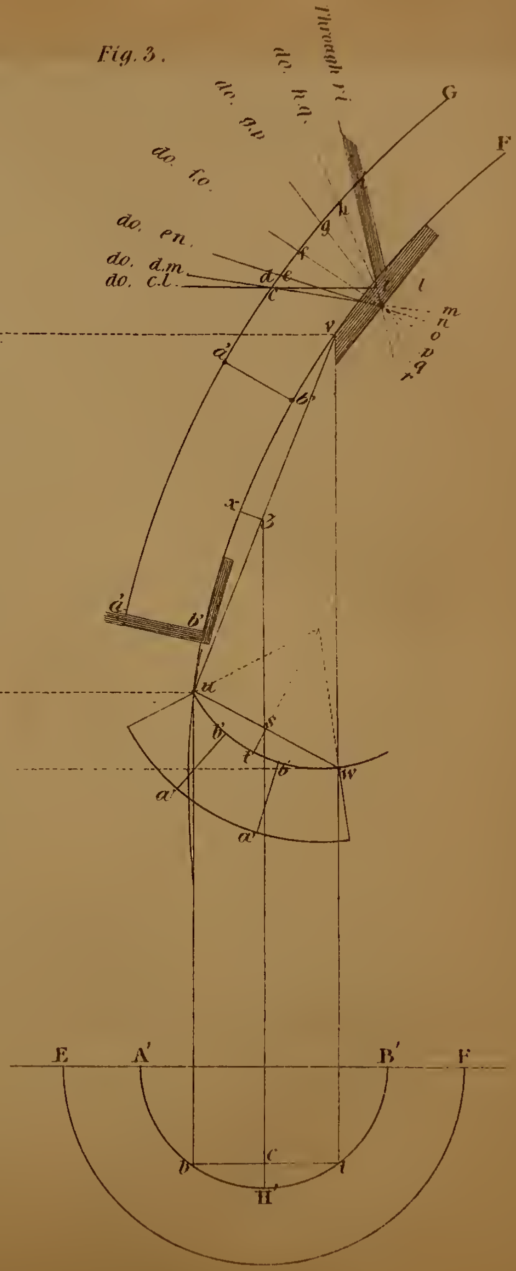

Fig. 3.

[illegible] Lith. to the Queen

THE ARTIZAN.

No. X.—OCTOBER 31st, 1843.

Art. I.—MODERN ART IN GERMANY.

The readers of the *Artizan,* those of them at least that live in London, did not fail, we venture to affirm, to visit the Cartoon Exhibition at Westminster Hall. If they asked themselves the question, how it came to pass that such an exhibition was to be seen in the metropolis of the British empire? the answer readily presented itself—because it was purposed to decorate the new Houses of Parliament with paintings *al fresco.* This answer, however, though true, does not exhaust the inquiry; for it suggests the further question, why has it been purposed to decorate the walls of the new Houses of Parliament with paintings *al fresco?* The answer is, because in Germany such decorations have recently been introduced into buildings, public and private, with extraordinary success; and because, simultaneously, and, to all appearance, commensurately with that success, there have been excited among the inhabitants of that country, an activity in the production of works of art, and a desire for the enjoyment of such works, that must lead to great, because beneficent, results. A select committee* on the Fine Arts, appointed to consider, more especially, whether and how the new Houses of Parliament should be decorated, made its report in the year 1841. That report insists on the value of artistic decoration in public buildings, and the necessary combination of the three arts of design for that purpose; the illustration is Munich, and the words of Cornelius himself, addressed to a member of the committee, are quoted to show that the opportunity presented by the great national building should be eagerly seized on. It is to Munich that the report refers for proof, that paintings in fresco are the most suitable ornaments for buildings; and that in such paintings only can art receive the impress of nationality, because, as they cannot excel in producing the effects of nature, their charm and power must depend on firm and correct drawing, on character, on dramatic energy—in short, on the qualities that will be found united in the works of the Bavarian school. It is to Munich that the report refers when the durability of frescoes is considered; and to Munich finally is he recommended, who would acquaint himself with the technical details of the style to which preference has been awarded.

He who walks down the western side of Regent-street cannot fail to have his attention arrested by the shop of the gentlemen who are agents for the German Art Unions. He will see in the window, engravings from pictures by some of the celebrated modern German artists. The first thing that will strike him in them is the distinctness of the style from any with which he is familiar. Depth, intensity, earnestness of feeling, and the grand simplicity which such properties of mind engender, sever them from all community with other productions of modern art. There is a wealth of suggestion in their noble singleness, in the severe subordination of all the accessories, in the austere disregard of mere ornament and refined prettiness, compared with which the affluence of forms, accumulation of groups, and multiplication of details—that constitute the pride and glory of other schools—appear poor, nay, worse, meanly pompous.

There is a painter of some reputation, whose name is Herbert. In melodramatic subjects, in what may be termed the Coburg Theatre school of art, he is unsurpassed; as unapproachable in the conception and execution of stage horrors, that is, of atrocities committed by people dressed in the traditional romantic costume of our theatre, as is Mr. Wallack in the delineation of the *Brigand.* This gentleman has been in Germany, or he has seen engravings from the pictures of Veit, we know not which, and what is the consequence? He has abandoned the style in which he excelled, and for which nature fitted him, to essay the sublimest undertakings of art—the illustration of Christianity. It is very true that he has not succeeded, any more than the favorites at the Surrey or Victoria Theatres would succeed in representing Shakspeare's heroes; besides that, as Michael Angelo observed, "he who walks in the footsteps of another must remain behind;" but that is of no moment, it is the fact that is noticeable.

A writer, who comments on the Cartoon prizes, in the October number of "The New Monthly Magazine," a man of some capacity and knowledge, but who, in his criticisms, appears to have forgotten that the judges were bound to consider the works submitted to them in respect of their fitness for subsequent execution in fresco, and not as mere pictures or drawings, sees the influence of German art in several of these beautiful designs. He does not hesitate, indeed, to state boldly that Townsend and Horsley must belong to the Düsseldorf school. We doubt the correctness of this assertion, though it is impossible not to see that the genius of Townsend is of kin to that of Kaulbach; but, be the statement correct or not, the fact that it faithfully describes the impression of a man who has some knowledge of the subject, and the power of arriving at fixed and definite opinions concerning it, is worthy of observation.

What, then, is this same German art, that fascinates our painters, imposes on our legislators, startles us with its solemn beauties as we pass through the streets? If it indicate the latest, though not the last, stage, in the march of Germany towards intellectual excellence, is this stage to be trod by the German mind only, or may the spirits of another race compass the same eminence; and if so, how? In any case, whence the impulse, what the sustaining vivifying principle, that has made the Germans, at all events—and no matter what the comparative merits of their school or schools—the most essentially artistic people of the present day; and that within the memory of the youngest bearded man that breathes? These are questions which remote posterity alone will fully answer; yet is it possible to adumbrate the truth, and to answer the question of the what, though we must be silent when interrogated as to the why? We may describe German art, and sketch its history, though it may be out of our power to eliminate the pshychological principle which it veils. To do this properly, however, we must go back a little; rather farther than the present King of Bavaria, or the establishment of schools of design, and not quite so far back as the introduction of erudition or Catholicism. We cannot conceive that the King or his normal schools could have effected much, or anything, but for something in the people wholly independent of either; and it must be obvious to every one that erudition and Catholicism, if they are the only causes, ought to have produced their effects long ago. In short, we do not agree with M. Fortoul; neither do we agree with certain estimable persons who thought themselves bound, when giving evidence before the select committee, not only to describe what they had seen, but to account for it. It has been said, however, that one man, Cornelius, is the master of modern German art. That may or may not be true; but, then, what made Cornelius what he is? His predecessors, his rivals, his position, his times, all working on, with or against, his genius. Now, from the times of the younger Holbein to those of Mengs, Germany may be fairly said to have been barren of art; since Mengs the succession of artists has been uninterrupted. From this point, then, we will set out.

Raphael Mengs was born at Messig, in Bohemia, in 1728, and educated at Dresden, where, at the age of eighteen, he was nominated painter to Frederick Augustus, Elector of Saxony and King of Poland. In the year 1752 he quitted Germany for ever, and established himself successively at Rome, Naples, and Madrid, everywhere earning renown and enjoying favor. The ceiling of the Villa Albani, which represents Apollo and the Muses on Parnassus, is that one of his works best known, and is the best evidence of the revolution which he attempted to bring about. He felt the defects that belonged to his era, and sought to restore the feeling for drawing, which not only did not exist, but was almost forgotten; as a consequence, he became sculptural and mythological. His originality, which is also the originality of his age, is a sentiment of the antique; for the rest, he was an imitator, of the ancients on principle, of Correggio from taste, of Raphael by force of reflection. Contemporary with Mengs was the celebrated Winckelmann, the author of the "History of Art among the Ancients," the founder of the doctrine of the Ideal, or ideal beauty. He was a man of immense learning and wonderful enthusiasm, and by means of a work, which it is impossible to read without the profoundest emotions, he succeeded in establishing the supremacy of his doctrine. "To make a beautiful figure," he says—and his proofs are examples from the antique—"several parts must be put together, each chosen singly for its beauty, from nature, or from existing models." This, it will be felt, was to preach the destruction of all distinctive styles, of all essential diversities, and to sacrifice all differences to the Pantheism of the Ideal. Thus, with Mengs practically recommending it, and Winckelmann theoretically, but most eloquently, enforcing it, were the Germans led towards that worship of the antique and the ideal which is so utterly opposed to the Christian and individualised performances of their painters in the present day. The effect produced by Winckelmann was increased by the publication of Lessing's "Laocoon."

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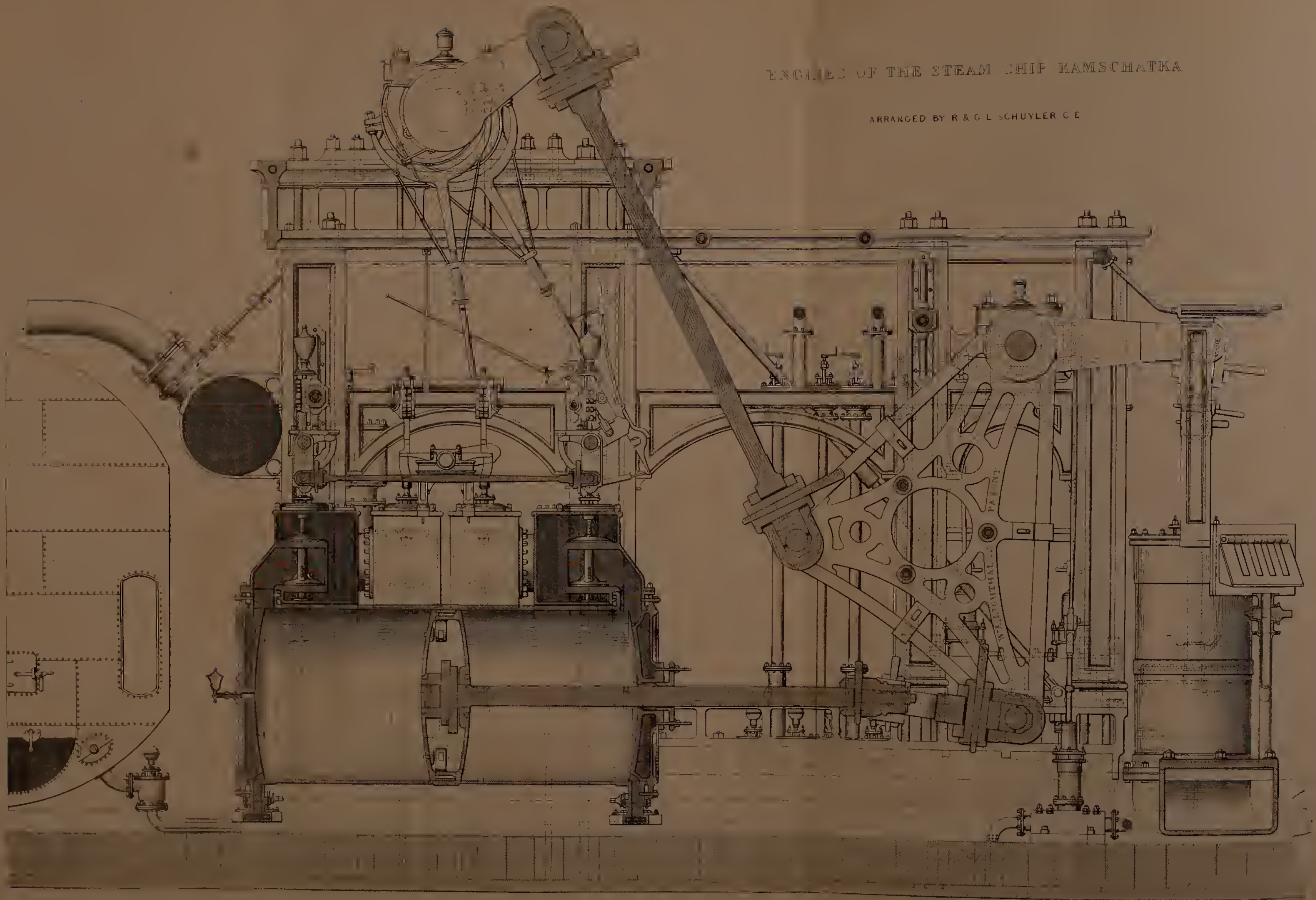
* Mr. Hawes, Mr. Labouchere, Sir Robert Peel, Mr. Hume, Mr. Gally Knight, Mr. Wyse, Mr. Blake, Sir Robert Inglis, Lord Brabazon, Lord Francis Egerton, Mr. Ewart, Mr. Milnes, Colonel Rawdon, and Mr. Hope.

ENGINES OF THE STEAM SHIP KAMSCHATKA

ARRANGED BY R & G L SCHUYLER C E



Longitudinal Section

Lessing, indeed, corrected and qualified the doctrine of the Ideal, especially by pointing out that diversified beauty must be the object of painting—for who does not feel that colour is the element of particularisation?—but he converted the taste for the antique into a passion.

In the year 1805 Goethe published a work "On Winckelmann and his Age." It completed what the subject of the work had begun. The great poet strives to show that the subjects of Christianity are not favorable to art, and endeavours, by means of profound interpretations, of interpretations opposed to what has been happily called Lempriereisms, to awaken the enthusiasm of his countrymen for Greek mythology. He has but little fault to find with the application of Winckelmann's ideas, save their tendency to exaggerate the importance of sculpture. In order to withdraw painting from the influence of this rival art, he proposed that the play of light and colours should be modelled on the vague but melodious effects of music. It is beside our purpose, however, to pursue this. Of the effect produced on art by certain other writings of Goethe, we shall have to speak anon.

The artist who most successfully applied the ideas of Winckelmann was Asmus Jacob Carstens. He was born at Schleswig, in Holstein, in the year 1754; his father was a miller, and he spent many years of his life in circumstances that would have stifled all feeling for art in one less gifted. His mother taught him drawing, and at length, yielding to a passion that was irresistible, he set out for Copenhagen, which he soon quitted to proceed to Italy. Alone, on foot, without money, without protection, and almost without talents, he traversed Europe, and arrived at Milan. There, on the very threshold of the paradise for which he had sighed so long, want and misery compelled him to retrace his steps. By the sale of some drawings in Switzerland, he was enabled to reach Berlin, where he soon attracted notice, was named a member of the Academy, and finally obtained from the Government the means of undertaking a second journey into Italy. He reached Rome in 1792, and died there in 1798. Koch, Wächter and Schick, were his principal pupils; Henry Tischbein, and Kugilgen, the chief among his followers. It is in the drawings of Carstens, preserved at Weimar, that the most natural expression of his thoughts is to be found. The subjects are ordinarily from the antique, the style grand and simple, the lines exquisitely delicate, the character superior to all the rest. His notion was, and therein he was far more consistent than Winckelmann, that an artist, being from education a master of the forms of nature, ought to fashion his subject in conformity with his ideas, and not with external objects. This opinion had great influence on the ulterior development of German art; and as he was in the habit of professing it publicly, a French artist, whom he met at Florence, challenged him to give practical proof of its soundness. Carstens at once accepted the challenge, shut himself up for fifteen days, and composed, without models, a large cartoon, representing the battle of the Centaurs and Lapithæ. The vigour of the action, the beauty of the attitudes, the variety of the episodes, and the grandeur of the landscape, prevent the eye from observing some few incorrect lines, which, indeed, add to the potency of the effect. His greatest work is "Homer reciting the Iliad before the assembled Greeks." The bard is to be seen in all the majesty of his genius, in all the misery of his blindness, his nakedness; in the figures of the crowd that surrounds him may be read all the diversities of human character, rendered with a familiarity that wants not elevation; a whole Iliad—here an impetuous Achilles, there a faithful Patroclus; at one spot a manly Ajax, at another an amorous Briseis; the chaste and reserved Andromache, the sage Nestor, the discreet Ulysses; all that he had once seen or often heard in the songs and stories of minstrels more ancient than he; all the grand moral types of the human species, converging, with their essential distinctions, towards that beauty which is eternal—is to be seen on this sublime page. His last picture was well calculated to show the sufficiency of mythology for powers the most accomplished, and knowledge of human nature the most profound. It is the terrible scene in "Sophocles," in which Œdipus learns that he is the son of Labdacus. The king is seated, crushed by destiny; three admirable figures, the chorus, gaze with awe on the mysterious abyss that yawns before them; Jocasta rushes from the place with a gesture that bespeaks all the horror and remorse of incest; while Creon observes Œdipus with a calm eye, in which may be read the irony inspired by the instability of human things, and the secret hope which his ambition founds on the misfortunes of his sister. The pupil and successor of Carstens, Joseph Koch, a Tyrolese, has engraved twenty-four compositions of his master, that form a real poem. The subject is the Argonautic expedition. They are equal in beauty of inspiration to anything of Flaxman; there is in them, moreover, a noble familiarity of type, suited to the rough patriarchal character of the Argonauts, that cannot fail of pleasing modern taste; the landscape is marked by much elevation of sentiment, and a certain enthusiasm of thought serves, equally with the story, to give them character, and unite them into one harmonious work. The object of Carstens was to reconcile modern sentiment with ancient forms. He bequeathed to the generation that followed him examples and arguments that should have led to far different results. Even at this day there are men, distinguished by pure taste and much knowledge, who regret that the artists of their country have resumed the study of the old masters, instead of perpetuating and following out the principles and practice—in short, the traditions—of Carstens. But the artist cannot dissociate himself from the times in which he lives; the influence of social relations is irresistible.

The period which we have been endeavouring to characterise is that which extends from the year 1750 to 1800. Now, the last thirty years of this half century are remarkable, and will ever so continue, as the classic era of German poetry. In 1773, Goethe produced his "Götz Von Berlichingen," a grand picture of the old days of the Empire, of ancient privileges, and feuds, and franchises. In 1781, Schiller published "The Robbers," a work too well known to require comment at our hands. The other poets, each according to the bent of his genius, sang, under the inspiration of one of these works, either the old national legends, or the impassioned lyrics that proclaim the rights and emancipation of the individual man. In fact, a rebellion of the old Teutonic genius against the ideas, to which, in common with the rest of Europe, it had submitted, took place. The absolute sovereignty of the individual genius was incompatible with reverence for classic antiquity, with sympathy for Winckelmann's doctrine of the Ideal; and at the opening of the century the romantic school was waging an aggressive and successful war against classic taste, Greek models, the intellectual commonalty of nations, and the Ideal. The great poets and the great thinkers of Germany were opposed to this. Goethe, as we have seen, wrote against it; Schiller condemned it; Tieck, the two Schlegels, did their best to uphold the sovereignty of the classic system. But events sided with their opponents; the principles of the French Revolution, embraced with enthusiasm, served to increase that romantic feeling of nationality which poetry had roused from slumber; and the princes of the empire soon found it necessary to turn that feeling to account, for in it they recognised their only bulwark against the assaults of France.

It will be recollected the French revolutionary generals were in the habit of transporting to Paris the most celebrated works of art that might be found in the cities which they took, or the countries which they overran. Many foul epithets have been applied to them on this account, but altogether undeservedly, as the writer of this paper presumes to think. In the year 1803, some specimens of ancient art, the spoils of convents and churches, were sent to Paris, most probably as curiosities. This wound to national feelings induced certain inhabitants of Cologne, a city full of such treasures, to associate for the purpose of rescuing from destruction or exile the paintings of the Gothic schools. The brothers, Sulpicius and Melchior Boisserée, commenced the collection of a series of pictures relating to the ballads, the sagas, the romantic poems, which men were then, on all hands, exhuming from beneath the dust of libraries. Frederick Schlegel seconded their views, and gave new fire to their enthusiasm. Goethe gave them the benefit of his counsel, his lore, and his name; and in the year 1817 this collection, completed, was found to contain a series of compositions, that embraced nearly two hundred years. Along with Master William and Master Stephen, the old glories of Cologne's city, there figured in this collection the two Van Eycks, Hemling, John Mabuse, Israel Van Meckenen, Engelbrechten, Lucas of Leyden, Schoreel, Hemskerk, Martin Schön, Wohlgemuth, Kranach, Albert Dürer, each distinguished by the essential differences that resulted from his personal organisation, yet all bearing certain general characteristics that constituted an obvious and unmistakeable kinsmanship. This valuable series was the product of an era marked by the simultaneous and coextensive development of two principles, commingled in absolute fusion—namely, the Christian and the Teutonic. It naturally, then, became an object of enthusiasm, of study, of imitation, to a generation of artists, who had shared the dangers and the glories of their country. The collection of the Messrs. Boisserée was purchased by the King of Bavaria in the year 1827, for the sum of 375,000 florins (£39,000), and is now one of the most precious ornaments of the Pinacothek at Munich. This, however, is not the only collection that was formed under the same impulse and for the same object. The Canon Walraff and M. de Lyeversberg at Cologne, M. Bettendorf at Aix la Chapelle, M. Nagler at Frankfort, and the Councillor Meyer at Minden, have similar galleries.

A collection of another kind made some time afterwards, effected a further modification of taste, and rendered their national art more dear to the Germans, by shewing its resemblance, the identity of its principles, with an important epoch of Italian art. Madame de Stael had already pointed out the relationship of Albert Dürer, Lucas Cranach, and Holbein, with Perugino and the other predecessors of Raphael, when a Mr. Solly, an English gentleman, residing at Hamburgh, set about collecting Italian pictures. Hirt, of Berlin, was his counseller, and as some German artists, whose taste had been formed by the Boisserée collection, sent home glowing reports concerning those artists, whom Vasari only mentions to enhance the glory of his own contemporaries, Mr. Solly determined to buy the works of masters anterior to Raphael. He proceeded with spirit, and by the year 1820 had completed a gallery, which the King of Prussia readily purchased at a price of £100,000—a gallery that may be considered as the manifestation of the religious genius of Christian Italy. This selection formed the basis of the museum at Berlin. Hereupon M. Rumohr, a Dane, was sent to Italy by the Prussian Government for the purpose of increasing the works of the earlier Italian masters. He was accompanied by the brothers Tieck, the poet and the sculptor, and got together a choice collection that was afterwards added to the museum at Berlin. More important in results than this collection, however, was the work which he afterwards published under the title of *Italiänische Forschungen* (Italian researches). He is altogether devoted to the romantic school. The work is on many accounts valuable; the influence of geographical situation on the distinctive character of the schools which have rendered Italy illustrious, is a monument of bold and ingenious criticism, worthy, indeed, of Arnold the historian.

The effect of the work was the confirmation of those ideas and that taste which the Boisserée collection, and the circumstances in which it originated, had engendered.

Let us pause for an instant to sum up what has been said. We find the generation that succeeded the most glorious one of German poetry, rebellious against the authority of the ancients, romantic, legendary, and national in its poetic aspirations. The war with France, the French occupation, the war of liberation, lash into passion the feeling of nationality; the Boisserée collection, completed just after the peace, nourishes this feeling in art, when the excitement of war has passed; the Solly collection gives to the taste already created all the authority that is derived from ancient observance and ancient excellence; the one is found at Munich, the other at Berlin, the two foci of antagonist civilization; then comes the work of Rumohr to justify the predilection for ancient art. But, it will be asked, what were the artists themselves doing all this time; since the days of Carstens and Koch? This question must now be answered.

Whilst the French were in occupation of Germany, and, haply, laid the foundation of its future unity, by this violation of its independence, certain young artists, big with the love of national art, sought a home at a distance from that country, where they found themselves in every sense of the word exiles. They chose Rome as their city of refuge, and there, in fear and destitution, but in steady enthusiasm, they passed their days. So poor were they, that each in his turn had to serve as a model for the other; but they were rich in the raptures which the Eternal City, with its basilicas and catacombs, its countless treasures of early Christian art, called forth. Their principles express pretty clearly the conflict of national and legendary romance with the older classic system. Of the old doctrine of the Ideal they acknowledged this much, that a painter ought to take his own idea for a guide in the composition and execution of his works; but they denied all authority to types of any kind, and insisted on absolute liberty in the choice of forms. The practical consequence was, that they abandoned the classic models; but, instead of inventing others, they imitated all the distinctive features proper to the schools of Bruges, Cologne, and Nuremberg. Now it is worthy of note that the figures which adorn the works of Van Eyck, of Lucas of Leyden, and of Holbein, are portraits. So full of the principle of imitation were these old masters of Flanders and Franconia, that they repudiated the elegant costumes of oriental art, and clothed the first saints of Christianity with the doublets, hoods, and jewels which they saw worn by the great merchants of the Hanse towns and the patricians of the imperial cities. The Germans at Rome, true to the idea of Carstens, averse from the classical system and the doctrine of the Ideal, refused to copy from nature, refused to imitate the antique; there remained for them the heads that had been real in the fourteenth and fifteenth centuries, and which, from the singleness of sentiment and candid faith that pervade them, are, in the nineteenth century, ideal, and nothing else. At Rome the young artists found objects of study that confirmed some of their tendencies, changed others, and enlarged all. In the catacomb and the basilicas they saw the uncouth images of the earliest Christian art. In the pictures of this period, which has been properly styled the Byzantine, there are a grandeur and majesty that remind the spectator of the principles that govern the ancient Greek idealism. In the second period, of which Giotto in the fourteenth century was the marvel, grace, tending towards nature, modesty, and delicacy, took the place of that præternatural vigour which prevailed in the first. The third period, that which follow on the revival of antique taste, mingled the majesty of the first period with the grace of the second to produce forms more correct and more animated. The predilection of the Germans was for the works of the second period, of which the masters had been in mind akin to the early artists of their country.

From the day when Raphael, deserting the simplicity of the Umbrian school, modelled his works on antiquity just exhumed from its ruins, Paganism had not ceased to consolidate itself in the city of the Popes, thence to extend its dominion over the rest of the world. The mythology of Albano and the materialism of Caravaggio had been the last consequences of the system that was inaugurated with so much glory at the Vatican in The School of Athens. From that time forward other nations visited Italy only to enlarge their notions of antiquity, and find reasons for their subjection to it. At length came the men from the country of Luther; they disinterred the Christianity of the art of the Eternal City from beneath the superstructure of Paganism that had been reared upon it; they took possession of that heritage which Perugino had received, which Raphael had renounced. This is the revolution which they have effected; nor is it the least curious revolution of this age, so fertile in change.—And now to persons.

Frederick Overbeck conducted the first of these pious pilgrimages. He was born in the year 1789, at Lubeck, a city filled with monuments of mediæval art, with the forms of which his mind was early impregnated, In the year 1806 he went to study painting at the Academy of Vienna, where the principles of Mengs, Paganism and the anatomical imitation of nature, reigned supreme. The efforts that were then made at Vienna to rouse the instinct of German nationality, the songs of poets, the pamphlets of professors, the sermons of priests, all tended to strengthen the ideas and nourish the taste which from infancy had reigned in his mind. He had no sympathy with his teachers; he had besides the double fault of inveighing against the use of models and affecting the style of the old German masters; so he was compelled to quit the Academy. Nothing dashed, he persuaded his class-fellows, Vogel of Zurich, and Pforr of Frankfurt, to accompany him to Rome, and there they arrived in 1809. He commenced at once his picture of Christ entering Jerusalem; but, before two years had elapsed, Pforr was dead, Vogel had returned to Zurich, and another German, Wintergarst, the present inspector of the gallery at Düsseldorf, who had joined them, had repassed the Alps. Overbeck was alone for a short time; but, in 1811, Peter Cornelius and William Schadow joined him. The former had received a sort of education at Düsseldorf, where he was born; but he, too, had a quality—an energetic and impatient imagination—that rendered him an object of dislike to the professors, zealous partisans of the school of Vienna and of David. He had already composed some illustrations of Goethe's "Faust," remarkable for character and boldness of thought, and came to Rome to design illustrations of the "Nibelungen Lay," and to execute the "Apotheosis of Attila," in the face, as it were, of the monuments of ancient civilization. Schadow, on the other hand, was very young when he arrived at Rome from Berlin, and may be said to have made his studies in Italy, where he distinguished himself less by powers of imagination, than by charms of colour, refined and modest effects, exactness, and meditation. For several years these men remained unknown, devoted to study, not in Rome alone, but in Florence, Orvieto, and other places rich in the treasures of art. Throughout the privileged land of Italy they found painting united to architecture, each of these arts sustaining and enlarging the potency of the other, and this union maintained so long as the people had durable thoughts to express. They became acquainted with the dignity and power of monumental painting, and they concluded that the moment of their real triumph would have arrived, when they should find their ideas sufficiently daring, their skill sufficiently accomplished, for the execution of large frescoes. Had their studies been interrupted, the result might have been different; but they were obscure men, and the march of self-improvement was neither broken nor diverted, and they reached the summit of their art.

The events of 1815 crowned the desires of the princes of Germany. The only real satisfaction that was accorded to the spirit of German nationality, that docile instrument of their victory, was the attention and favour that were bestowed on the efforts of those artists who had sought to freshen the art of their nation at the common source of Christian art. The Prussian consul at Rome, M. Mendelsohn Bartholdy, was the first who thought of giving to these innovators the encouragement for which they sighed. He invited them to adorn a saloon in his house with frescoes, representing the history of Joseph. Then it was that Overbeck and Cornelius shone forth in all the diversity of their talents. The first in his two compositions of "Joseph sold by his Brethren," and "The Seven Years of Scarcity," exhibited all the ties that bound him to the ancient German schools, and which the study of Italian works had failed to loosen. He not only preferred the thin and lank figures which, in the fourteenth century, were common to all these schools, but adopted the anachronisms of costume that were familiar to them, and clothed the Arab merchants of the Bible with the gold chains and furred garments, with which the Van Eycks and Lucas of Leyden had arrayed the Hebrews of their pictures. His style, moreover, was more nearly allied to the stiffness of these masters, than to the suppleness of Giotto and the elegance of Fiesole. It was by degrees only that the delicacy, perseverance, and devotion of his nature, permitted him to lay aside the Teutonic forms and appropriate those of Italy. Cornelius, on the other hand, all fire, boldness, and impetuosity, appeared at once so vigorous, so advanced, so fit to render the most discrepant epochs of art ductile to his purpose, that all men augured his ascent to the very pinnacle of art, if, indeed, he was susceptible of further improvement. Nevertheless, his two frescoes, "Joseph recognised by his Brethren," and "The Interpretation of the Dreams," exhibited, independently of the radical vice of incorrectness, a very dangerous tendency towards applying to fresco, a style essentially grave and simple, all the fire of design and colour that is proper to pictures. The contrast between the mystic sweetness of Overbeck and the violent science of Cornelius was striking; and men said that, even as St. John and St. Paul represented the two aspects of religion, so these masters represented the corresponding aspects of art. The two frescoes of M. Schadow, representing "The Dream of Joseph," and "Jacob receiving the bloody robe of Joseph," are less remarkable for great qualities. A young man, who had come from Berlin in 1815, Philip Veit, completed the paintings of the Bartholdy saloon, by adding "Joseph and Potiphar's Wife," and the allegory of "The Seven Years of Plenty." These works displayed the most noble harmony, a lively imagination, design natural and elevated, and colour at once rich and sweet. Canova commissioned this young German to paint a compartment in the hall of a corridor of the Vatican, on which were to be represented the different monuments of the city. The Coliseum was the subject given to Veit. He was not satisfied with copying the romantic ruin, as so many would have done, but painted the Virgin appearing to a pilgrim that seeks the ancient chapels lost amid the wreck of the Roman monument. The young French artists at Rome, who theretofore had made the Germans and their labours the subject of raillery, saw that Virgin, and confessed that these same Germans were effecting a revolution that would spread over the face of Europe.

In the year 1818 the Emperor Francis visited Rome, and the little German colony had become sufficiently numerous to have a public exhibition of its works in the Cafarelli Palace. The Germans had been eight years in Rome, yet so completely had they been buried in silence and solitude, that then, for the first time, did the greater part of the inhabitants and strangers sojourning in that city become aware of their existence. In the same year the Marquis Massimi engaged the German artists to decorate his villa with frescoes, the subjects to be taken from the great epic poems of Italian literature. Overbeck was commissioned to execute those from the "Jerusalem Delivered;" Cornelius, those from the "Divine Commedia;" and a young man, who had arrived from Leipzig in 1817, and had distinguished himself in the exhibition at the Cafarelli Palace, Julius Schnorr, those from the "Orlando" of Ariosto. If, in such performances, fidelity to the genius that conceived the subject be essential, the work of Overbeck must be condemned, despite its charms. His painting represents such a legend of the Crusades, as a contemporary of Dante, more or less learned, but full of the quaint dreams proper to a candid soul, might have sung. Considered, however, without reference to the poem, the compositions cannot fail to please, by their grace, delicacy, simplicity, and natural yet exalted character. In these works the artist had begun to lay aside his predilection for the old German masters, and approached nearer to Giotto and Fiesole, who, with a like tendency towards the natural, had, in a superior degree, a feeling for beauty and the Ideal in art.

Cornelius, who was engaged to paint the "Paradise" of Dante on the ceiling of a saloon in the Villa Massimi, composed designs, which his recal to Germany prevented him from executing. The outlines have been engraved, and are amongst the most beautiful things that have issued from his hands. The style, which is extremely masculine, possesses, nevertheless, all the qualities of brilliant and poetic youth; it breathes the rude accents that passed from the Dorians to the Byzantines, and from these again to the illustrious Florentines. Veit replaced Cornelius, and made new compositions of a very different character. The sweetness of Beatrice, *dolce guida e cara,* becomes, under his pencil, the dominant character of the scenes of "Paradise;" it is, however, a sweetness more large and opulent than that of Overbeck, which, undoubtedly, is more delicate, but also more scrupulous. Veit did not finish his work with his own hands, and the piers of the walls were covered by Koch, the venerable pupil of Carstens.

Schnorr treated Ariosto pretty much as Overbeck treated Tasso. He thought more of truth to the subject than of truth to the poet, and gave to the rude companions of Charlemagne the costume and the vigour of the times to which they belonged. Full of the poetry of the sagas, the Heldenbuch, and the Nibelungen, he sought and found the arms and vesture of the heroes whose souls were depicted in those legends. Thus, while the paintings of his friends were restoring religious art, he restored historic art. The frescoes which he executed in the Villa Massimi astonished the Italians by their unexpected originality. Though somewhat episodical in manner, and unequal, there is a firmness of colour, facility of design, and elevation of character in these performances, that made the artist one of the foremost men of his school. The works of Vogel, Zenf, Olivier, Näcke, Eggers, and Rebenitz, would deserve notice in connection with this epoch, but we must proceed.

The first consequence of the celebrity obtained by the Germans in Rome was the arrival of several Germans who had been studying in France; among them, Hess and Charles Begas. In 1821, Hess arrived from Munich; but the revolution which his countrymen had effected was already felt on the other side of the mountains. The entire field of study and discovery had been traversed; it was time to quit the spot where so much had been done, and spread the results over Germany. Hess, despite the incontestable superiority of his genius, found nothing new to do in a country where novelties had been so rife. Guided by the example of Overbeck, he embraced the principles of the Italian painters of the second epoch, and sought no originality other than that of diffusing them over his country.

One important fact remains to be told. These German artists renounced the reformation even as they had renounced the revival, and embraced the Catholic religion. Overbeck studied the picture of the Madonna, towards which the native grace of his genius drew him, until he thought that to the production of her divine beauty there is necessary a heart which, penetrated with faith, pays to her that homage which the Roman Catholic church has decreed as her due. He commenced the study of Roman Catholic theology, the mysteries of which soon gained his excited and contemplative spirit. Many of his friends, William Schadow, Vogel Von Vogelstein, Philip Veit and his brother, Eggers, Müller of Cassel, successively abjured the religion of their fathers. Schnorr, whom the bent of his genius exposed less to the seductions of religious art, Wach and Begas, whose places in the Academy at Berlin were already marked out, resisted the general impulse. Herein they were supported by Thorwaldsen, who shared the other ideas of his friends, but was defended by the Polytheistic genius of sculpture from any bias towards Christian mysticism.

The difference of religious opinions produced considerable dissensions in the German school at Rome. The schism was followed by the almost total dispersion of the artists whom we have seen assembled to do homage to the same principle and in the same place. We shall show them, if another opportunity be offered, established as masters in the different schools of Germany, into which they imported a principle of vitality and fertility that is far from having produced all its fruits. Overbeck alone remained at Rome, like a guardian angel watching over the purity of the sanctuary in which the renovation of national art had been accomplished. An examination of the works which he has executed, and of the principles which he has developed, since the epoch of his conversion, would be the natural complement of the foregoing narrative; but the imperiousness of space must not be gainsaid.

Art. II.—THE ATMOSPHERIC RAILWAY.

Atmospheric propulsion on railways is now an *accomplished fact*. The extended experiment on the Dalkey branch of the Dublin and Kingstown Railway has proved that this mode of propulsion is practicable on a length of line sufficient for the application of the system, even supposing the exhaustion of the air could not be maintained on longer lines than the one just completed. It now becomes an important question, therefore, to consider whether this system, the practicability of which has been shown, possesses any advantages over the locomotive plan, and if so, to what extent railway travelling may be improved and cheapened by the adoption of the new mode of propulsion.

To the readers of the *Artizan* it will be scarcely necessary to describe the general principles of the atmospheric railway, but there are some details connected with its practical application which it may be desirable to explain, as the applicability of the system depends principally on the mode of keeping the pipe air-tight. It is generally known that in the atmospheric railway a pipe of about twelve inches diameter is laid between the rails on which the carriages run, that this pipe is exhausted at one end by an air-pump, that a travelling piston is forced along it by the pressure of the atmosphere, and that a rod, or plate, of iron, connecting the piston with the carriages, traverses a slit on the top of the pipe. The great difficulty to be overcome was to cover this slit with a substance which would be air-tight, and yet would permit the connecting rod to pass without offering much obstruction. The plan adopted by Messrs. Clegg and Samuda, the projectors of the system as improved, will be best understood by reference to the accompanying diagrams.

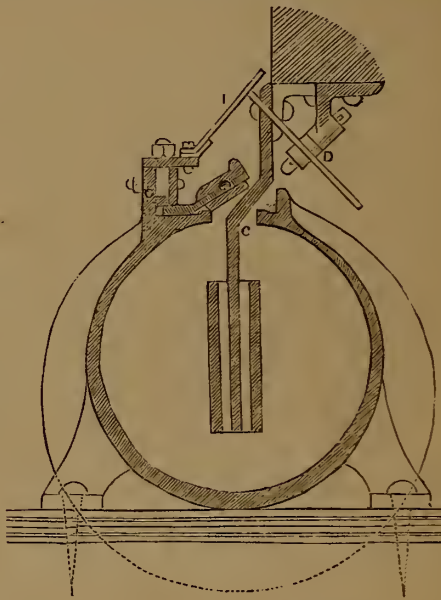


Fig. 1.

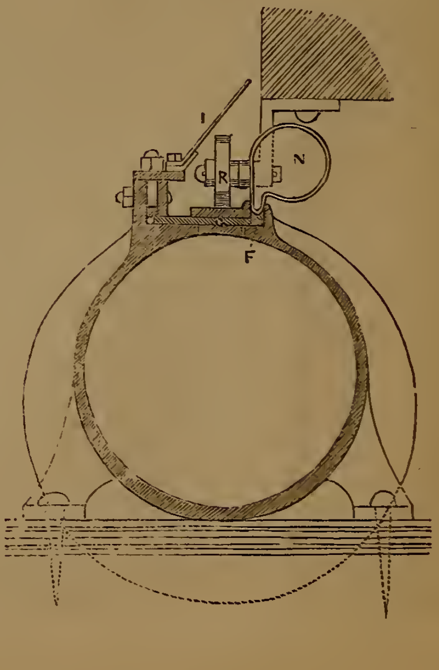


Fig. 2.

Fig. 1 represents a vertical section of the pipe. The opening at the top is covered by a continuous valve G, extending the whole length of the pipe. It is formed of leather riveted between two iron plates. The upper plate is wider than the slit, and prevents the leather from being pressed in by the pressure of the atmosphere; the lower plate just fits the slit, and is curved to the shape of the pipe. One edge of the leather is fastened to a longitudinal rib, cast along the opening, and forms a hinge, as on a common pump valve. The other edge of the valve, when it covers the opening, forms, with a ridge cast on the pipe, a channel, or trough, on its whole extent, a section of which is shown at F, fig. 2. This trough is filled with a composition of bees-wax and tallow, which, when melted and cooled, adheres to the side of the valve, and keeps it air-tight. As the travelling piston is forced along the pipe, one side of the valve is raised by four small wheels fixed behind the piston, so as to admit the connecting rod C to pass, as represented in fig. 1. The opening thus made also admits the air to act against the piston. The rupture thus made in the composition of wax and tallow is cemented again before the train passes, in the following manner:—A steel wheel R (fig. 2), regulated by a spring, is attached to the carriage, and presses down the valve immediately after the connecting arm has forced it open, and a copper heater N, about 5 feet long, filled with burning charcoal, passes over the composition and melts it, thus leaving the valve air-tight as before, and ready for the next train. A protecting cover, I, formed of thin plates of iron about 5 feet long, and hinged with leather, is placed over the valve, to protect it from rain or dust. It is contemplated to have each pipe about 3 miles long, with a stationary engine for each length of piping to exhaust the air; and an arrangement is made by means of which the piston, as it approaches the end of the pipe, opens a valve which admits it into the next length of piping, so that the train may proceed from one to the other without stopping.

It is evident that as the tractive force is derived entirely from the pressure of the atmosphere on the piston, its amount will depend on the area of the piston, and on the extent to which the exhaustion of the air can be carried by the air-pump. It must also be evident that the difficulty of keeping the pipe air-tight will increase with its length, and with the pressure obtained. The vacuum-pipe on the branch of the Birmingham, Bristol, and Thames Junction Railway, where the atmospheric system has been in operation for more than three years, is only 9 inches internal diameter, and but half a mile long. It is on an incline of part 1 in 120, and part 1 in 115. A vacuum, equal in some instances to a column of mercury 23½ inches high, has been obtained, and loads of 13 tons have been propelled at a speed of 20 miles an hour. On the Dalkey branch of the Dublin and Kingstown Railway, the pipe is 15 inches in diameter, and its length, so far as it has been tried, is one mile and a quarter. The average incline is 1 in 100; the exhaustion has been extended to 22½ inches of mercury, and three carriages loaded with passengers have been propelled up the incline at a speed exceeding 40 miles an hour.

Assuming, therefore, the practicability of the atmospheric system, the great questions to be determined are, the advantages it offers compared either with the locomotive system, or with the plan of traction by ropes drawn by stationary engines. We shall first compare the pneumatic mode of propulsion with that of locomotive engines. One self-evident disadvantage under which the locomotive system labours is the necessity of impelling the weight of the moving power, which amounts, engine and tender together, to nearly 20 tons, or one-third the average weight of a loaded passenger train of carriages. Another disadvantage arises from the mode of applying the power, and the inapplicability of locomotive engines, as at present constructed, to very rapid motion. The alternate motions of the pistons are so quick, and at the same time the orifice of the blast-pipe requires to be so contracted, that the waste steam cannot escape in sufficient time to prevent its reacting on the steam as it enters the cylinder on the other side of the piston, thereby tending directly to counteract its force. So great is the loss of power by locomotive engines when in rapid motion, that an engine which, on level rails, will draw a load of 346 tons at the rate of 10 miles an hour, will only draw 108 tons when the speed is doubled, and but 30 tons at a speed of 30 miles an hour; thus, by doubling the speed from 10 to 20 miles, the power is diminished more than three times; and by trebling the speed from 10 to 30, the load propelled is diminished to little more than one-twelfth the amount. A third disadvantage of locomotive engines is the wear and tear of the rails, caused not only by the great weight of the engine, but also by the circumstance that the rails constitute the fulcra whereon the leverage is obtained for propelling the train, consequently they must be liable to great strain and friction, especially in curves, and where there are any inequalities in the road. The frequent derangements of the machinery of the engines, and the numerous repairs necessary, are also serious impediments to the system of locomotion, and add materially to its expense.

From the special disadvantages we have mentioned the atmospheric system is exempt. It has, however, to encounter the friction of the travelling piston and of the connecting rod, the loss of power from leakage, and the wear and tear of the continuous leather valve. In the calculations of Messrs. Clegg and Samuda, they appear to have omitted the friction of the travelling piston and of the connecting rod, and to have considered the pressure of eight pounds on the square inch as so much tractive force to be applied without deduction to the propulsion of their trains. They estimate that a main pipe, 18 inches diameter, will contain a piston of 254 inches area, and assuming an average vacuum equal to produce a pressure of eight pounds on the inch, a tractive force of 2,032 pounds is calculated upon, which would draw a train weighing 45 tons up an incline of 1 in 100. A stationary engine of 110 horse power would, it is stated, be adequate to exhaust a pipe of that diameter, 2½ miles long, in four minutes, and trains might be started each way every quarter of an hour, and convey daily 5,000 tons. The loss from leakage is admitted to be very considerable. On the half mile length of pipe on the Bristol and Thames Junction Railway, one-eighth part of the power is estimated to be employed to overcome the leakage of the piston and valve; for when the engine is at rest, the vacuum is destroyed in eight times the number of minutes required to exhaust the pipe. These considerations of friction and of leakage must operate as serious drawbacks on the amount of tractive force actually gained by the atmospheric pressure; nevertheless, it appears, from the experiments on the short lines where the system has been tried, and is in operation, that the effective power of the stationary engines far surpasses the tractive force that could be gained by the consumption of the same weight of fuel in locomotive engines.

As regards the cost of construction, we believe little would be gained by adopting the atmospheric system, though the figures exhibited by Messrs. Clegg and Samuda represent a saving of £22,480 per mile in forming and furnishing their railway. To make out this account, they assume as the average cost of formation of railroads, £37,000 per mile, whereas on many lines the cost was less than £22,000, and if a single line of rails were laid down, with rather steeper gradients, it has been shown that a well-constructed railroad, adapted for all the purposes of traffic, might be formed for £17,000 per mile. The extra cost of the vacuum pipe would, indeed, nearly, if not quite, counterbalance the saving to be effected by the steeper inclines up which the atmospheric railway might be carried, and the cost of the fixed engines, air pumps, and engine houses would equal that of the original outlay for locomotive engines.

It is in the annual expenditure that we believe the most important advantage would be gained by the atmospheric plan. The maintenance of way, which constitutes a formidable item in the expenditure on ordinary railways, would, from the circumstances to which we have adverted, be comparatively insignificant; and the cost of the tractive power and the repairs of the apparatus are estimated, and with seeming fairness, at only one-third that of the locomotive department of common railroads. The annual saving per mile on the atmospheric system is stated at £1,460.

In point of safety, also, the atmospheric plan seems far preferable to the locomotive. No collision of trains could take place whilst travelling on the rails. The only possibility of such accidents occurring would be at the junctions of the pipe, and by nothing short of wilful negligence could they happen even there.

We have next to compare the pneumatic principle of traction with that by a rope, to which plan it bears the nearest resemblance. In working effect, however, the rope of air far surpasses the rope of hemp or iron. In the first place, the weight of a rope for a length of but one or two miles is nearly as great as a locomotive engine; therefore there is no saving of load by the rope traction. The rope which draws the passenger carriages from the Euston-square terminus of the London and Birmingham Railway to Camden-town weighs 11 tons, though the distance is but 1 mile and 280 yards. On the London and Blackwall railway, for a length of 3 miles 105 yards, the rope weighs not less than 40 tons, or more than the average weight of the whole trains. The weight of the rope, its friction against the sheaves, the frequent fractures, and the constant noise, are sufficient difficulties and inconveniences to prevent the adoption of that plan of traction wherever it can be avoided, and in comparison with it the atmospheric system stands pre-eminent.

It results from the consideration we have bestowed on the atmospheric railway, that, making allowance for the exaggerated statements of the projectors, and founding our estimate chiefly upon what has been actually accomplished, it is capable of being applied so as to afford a cheaper, safer, and a more convenient mode of conveyance, than locomotive railways, as at present conducted. The points respecting which we entertain the most doubt are the wear and tear of the valve, and the liability to the stoppage of the traffic, from requisite repairs of the vacuum pipe, supposing one only to be laid down. These are questions, however, which a short experience on the Dalkey branch of the Dublin and Kingstown Railway will determine; and, if they are decided satisfactorily, the public, who are now suffering from the exactions and inconvenient regulations of railway directors, will have cause to rejoice that a means of locomotion presents itself, promising to greatly reduce the cost of travelling, and to give much more convenience and safety.

Art. III.—PASLEY ON THE OPERATIONS OF A SIEGE.

Rules, chiefly deduced from Experiment, for Conducting the Practical Operations of a Siege. By Major General Pasley, R.E., C.B., F.R.S., &c. London: Weale. 1843.

Major-General Pasley is so well known as an indefatigable and successful labourer in the field of science, or rather as a most able director of the practical labours of others in the arts of engineering, both civil and military, that we welcome any new work of his with the pleasure arising from a conviction of its usefulness. The object of the present work is sufficiently indicated by its title, and if, in these unwarlike times—and long may they continue so—we call it a useful work, it is precisely because, from the want of real sieges in times of peace and their now comparative rarity, even in times of war, the modes of conducting them would soon be forgotten unless the knowledge were perpetuated by such works as the present.

The greater number of books hitherto published on the subject of sieges, whether by foreigners or by ourselves, are objectionable on many accounts; but it is not with these we have to deal, and we must confine our remarks to the work before us. We are informed in the preface that, "Whatever is laid down as a rule, has been deduced from numerous experiments; that which has not been fairly and fully tried is stated as a mere suggestion or untried idea." This of itself is sufficient to inspire confidence, and stamp the work with a degree of importance to which other treatises on the same subject can have no pretensions.] Nor let it be for a moment imagined that experiments in this matter can ever be at variance with actual practice, for they are, indeed, one and the same thing. The experiments here alluded to are not of that frivolous description exemplified in the case of small working models or miniature trials, and the result of which are so often falsified by more substantial operations. Here the experiments are all on the natural scale, and the materials employed and mode of employing them the same as in actual warfare; indeed, they are the operations themselves, merely divested of the dangers of a real siege. The work, then, is grounded on the best of all bases—actual practice—and the rules thus derived must and do constitute a sound theory. Nor is this all: General Pasley has perfectly understood the importance of method in instruction, and has so ordered the various topics treated in his book that the dullest comprehension requires but to apply ordinary attention to master the subject.

The work is in two parts; the first treats of the various materials used in the operations of a siege, and the rules for tracing and executing the several parallels in different circumstances, for arming and regulating the working parties, &c. This portion of the work is divided into ten principal sections, which are again subdivided. The second part of the work, divided into thirteen sections, is exclusively appropriated to the subject of siege-batteries and field powder magazines of all kinds and in all situations, and is extremely valuable as reducing this most important branch of the art of besieging to its simplest elements, while every conceivable case and circumstance is minutely considered; indeed, it is a complete monograph, and quite indispensable to those whose duty it is in times of peace to prepare for war.

The several subjects are elucidated by woodcuts, which greatly facilitate their comprehension. In a word, the work is one of the completest of its kind, and contains the results of the most approved modern practice. As for this practice itself, there are a few points of minor importance to which we are disposed to object. Thus, with regard to the mode of forming the step in the trench, as described at page 41, although its justification is attempted at page 43, we must beg to differ from the gallant general in his doctrines upon this matter. We think it would be a saving both of time and labour, and certainly procure much more solid work, to proceed otherwise than as stated at page 41. Thus, even allowing the full force of the reasons in page 43, which we are hardly inclined to do, we think the better way would be for the party at the first task to throw the earth sufficiently forward, so as to leave a berme of 3 feet instead of 1 foot 6 inches, from which those of the second task should *excavate* the step or banguette in the front of the trench. It is true this throwing off the earth farther would be a somewhat greater labour, particularly from the hinder part of the trench, and might even require more time, but, as a compensation for this, the labour of the second party would be more than proportionably lessened, and the work done infinitely better. With these considerations, the portions to be executed by the first and second parties might be somewhat altered, so as to equalise their labour. We offer this remark, however, with the deference becoming an *Artizan* when speaking of such subjects, and shall here only add, if our voice goes for anything, that we warmly commend the work to the study, not only of young military engineers, but to officers generally, who may frequently be required, in the absence of engineers, to execute field-works, and who will be the more likely to render important services to their country the more thoroughly they are acquainted with all the details of the art of war.

ART. IV.—ON THE HEALTH OF THE WORKING CLASSES IN LARGE TOWNS.

No. 3.

DR. CHANNING, the celebrated dissenting divine of America, in an able work on the "Elevation of the Working Classes," has a remark that strikingly bears on the subject to which we desire to awaken public attention. "We forbid by law," says he, "the selling of putrid meat in the market; why do we not forbid the renting of rooms in which putrid, damp, and noisome vapours are working as sure destruction as the worst food? Did people understand that they were as truly poisoned in such dens as by tainted meat and decaying vegetables, would they not appoint commissioners for houses as truly as commissioners for markets? Ought not the renting of untenantable rooms, and the crowding of such numbers into a single room as must breed disease, and may infect a neighbourhood, to be as much forbidden as the importation of a pestilence?" To promote the same great object which this good man had at heart, to awaken employers as well as workmen to the duty of calmly inquiring into the reality of the evils by which they are surrounded, with a view to their speedy and effectual remedy, to begin—if need be—a moral agitation that shall compel the interference of the legislature to stay the plague which is yearly sending between thirty and forty thousand of our countrymen to a premature grave, and, while showing the mischief in all its fearful varieties, to suggest, at the same time, the means of cure; these are the great ends we aspire to achieve by these papers, and which, with the resolute and persevering aid of the great class to which our pages are addressed, we have no fear of seeing accomplished. To this end it is not merely necessary that we should announce the momentous truths brought to light by our painful inquiries, but that we should insist on them; that we should repeat line upon line and precept upon precept, until even the most indifferent is aroused or softened, and a passive assent becomes an active living principle. No great truth was ever inculcated by being once said, and we are resolved to adhere to this momentous question until it has awakened that attention and activity which must result in effectual reformation.

In our last article on this subject, an endeavour was made to exhibit the bad consequences of overcrowded and improper habitations in London, Manchester, and Liverpool, by which we can prove, not only that the general mortality is greatly increased, but that there are certain classes of diseases consequent on such evils, and peculiar to the working classes, that are productive of a painfully multiplied ratio of deaths—deaths, the larger proportion of which, we may hope, will not happen whenever the work of sanitary reform shall have been accomplished. It will now be necessary to show the deaths in these districts by the leading diseases and classes of disease as compared with those in England and Wales, and the rural districts which constitute the healthy extreme of the registration districts.

Comparative Table of Mortality from various classes of disease in England and Wales, and three sections thereof; showing, also, the increase per cent. of the mortality in the region of the morbid over that of the healthy extreme.

Classes of disease causing mortality.	Healthy Extreme.	Mean.		Morbid Extreme.	Proportion excess per cent. of morbid over healthy extremes.
	1. Rural Districts.	2. England and Wales.	3. Metropolis	4. Manchester & Liverpool	
	Deaths to 100 living.	Deaths to 100 living.	Deaths to 100 living.	Deaths to 100 living.	
1. Epidemic, endemic, and contagious . .	·319	·425	·504	·994	312
Including small-pox .	·053	·059	·033	·137	258
Infantile epidemics	·150	·219	·324	·648	418
Typhus	·093	·101	·096	·148	159
2. Diseases of nervous system	·099	·320	·395	·548	554
Including convulsions	·035	·162	·154	·349	997
Hydrocephalus, or water in the head	·034	·049	·089	·099	290
3. Diseases of respiratory organs	·519	·589	·696	·993	190
Including phthisis or consumption . . .	·351	·401	·342	·584	165
Inflammation of the chest	·091	·115	·192	·259	284
4. Diseases of digestive organs	·104	·135	·157	·259	250
5. Atrophy and debility	·105	·109	·045	·085	none.
6. All other diseases .	·364	·327	·356	·420	115
7. Old age	·229	·222	·178	·149	none.
8. Violent deaths . .	·061	·073	·063	·095	186
	1·8 or 1 in 55½.	2.2 or 1 in 45.	2.5 or 1 in 39·5.	3.5 or 1 in 28.6.	95

⁂ The numbers in the last column express the difference between the deaths in divisions 1 and 4, the former being constantly 100.

Can any statement be conceived more fully illustrative of our meaning respecting the surplus mortality of great towns? It will hence be seen that epidemics are more than thrice as fatal in Manchester and Liverpool as in the rural districts, that diseases of the nervous system are more than quintupled, and diseases of the stomach rather more than doubled, while deaths by lung diseases in towns seem to be as 2·5 to 1 in the country. A very important consideration, however, to which we could call particular attention, is this: that the deaths of infants are increased *fourfold* by epidemics (small-pox, measles, hooping-cough, and scarlatina), *threefold* by water on the brain, and almost *tenfold* by convulsions! Suicides also are greatly increased in towns, and most of them are committed by persons belonging to the working classes.

In pursuing our inquiries into other towns of England, we must confine ourselves to a few of the principal; but it may be observed that, with respect to towns of the second class—as Blackburn, Wigan, Bury, Leigh, Preston, Oldham, Wolverampton, Walsall, &c.—we have information respecting their ill-paved, unsewered streets; low, confined, ill-ventilated habitations; and crowded, filthy, diseased population, that quite agrees with the notion already given of similar localities; and in these places also disease, emaciation, pauperism, and death, are the unceasing concomitants of domestic misery and want of economy. Respecting Leeds, Derby, and Birmingham, however—manufacturing towns of first-rate importance—it will be expected that we should furnish some detailed accounts, and, with reference to the first, we have ample materials from the sanitary report made by the town-council in 1839, which, we find, applies also pretty closely to the present period.

Leeds is situated on a slope running down towards the river Aire, which meanders about a mile and a half through the town, and is liable to overflows during thaws or after heavy rains. The higher or western districts are clean for so large a town, but the lower parts contiguous to the river and its *becks* or rivulets are dirty, confined, and, in themselves, sufficient to shorten life, especially infant life; add to this the disgusting state of the lower parts of the town about Kirk-gate, March-lane, Cross-street, and Richmond-road, principally owing to a general want of paving and draining, irregularity of building, the abundance of courts and blind alleys, as well as the almost total absence of the commonest means for promoting cleanliness, and we have then quite sufficient data to account for the surplus mortality in these unhappy regions of filth and misery. The influence of such causes on the health and life of the working classes is most distinctly seen in the following table:—

Districts.	Gross Population, 1841.	Population of Working Classes.	Proportion of Working Classes to Population.	Annual Deaths.
1. North and north-east wards	28,775	24,849	86·3	1 in 23
2. East, south, and Kirkgate wards	23,079	18,747	81·2	1 in 30
3. Mill-hill, west, and north-west wards	30,306	17,627	58·2	1 in 36
Totals . . .	82,160	61,223	74·5	1 in 34·6 (town only)

In consequence of the floods from the Aire, the dwelling-houses and cellars are not unfrequently so inundated that the water has to be pumped out by hand-pumps, on to the surface of the streets; and at such times, even where there are sewers, the water rises through them into the cellars, creating miasmatic exhalations, strongly charged with sulphuretted hydrogen, and leaving offensive refuse, exceedingly prejudicial to human health. Indeed, during a season of inundation in the spring of 1839, so fatal were the effects of such an engorgement of the sewers, that the registrar of the North district made a report, that during that quarter there were, in that neighbourhood, *two* births *to three* deaths, whilst in all the other districts there were *three to two* deaths. Other populous districts are wholly without sewers, or so inadequately provided as to derive no advantage therefrom. In some rows of houses, the cellar-dwellings are seldom dry; in another district, several streets are described as being "in that state in which a frequented road leading over a field to a brick-garth would be in wet weather." The inhabitants have from time to time vainly attempted to repair these streets with shovelsfull of ashes; and soil, refuse-water, &c., stand in every hole where a lodgment can be made, there to remain until absorbed by wind or sun,—"a perpetual nuisance to the eye, and a perpetual source of fever to the whole body."—(*Rep. of Town-council in Statist. Journal*, vol. ii. p. 404.) The confined size of the dwellings is another cause fraught with evils of a moral as well as physical nature. An ordinary cottage, in Leeds, extends over no more than about five yards square, and consists usually of a cellar, a sitting room, and a sleeping chamber. This small size of the houses, indeed, may perhaps be one of the causes of the tendency to consumption, which bears a high proportion here to other diseases, and prevails to a much greater extent than is generally imagined,—for there can be no doubt, that the vitiated atmosphere of sleeping rooms so confined, crammed almost to suffocation with human beings during both day and night, predisposes the system to lung-diseases. We believe, moreover, that this tendency to phthisis is in a very small degree if at all owing to the nature of the woollen manufactures. The Irish hand-loom weavers are here, as elsewhere, remarkable for that total indifference to comfort and decency, which renders them a bane to every population with which they commingle. With all this knowledge of the domiciliary condition of the working-classes in Leeds, how forcible must appear the eloquent appeal of Mr. Baker, in his letter to the Poor-law Commissioners! (*Local San. Reports*, p. 362.)

> "Can we wonder that such places are the hot-beds of disease, or that it obtains upon constitutions thus liberally predisposed to receive it, and forms the mortality which Leeds exhibits. Adult life, exposed to such miasmata, gives way. How much more, then, infant life, when ushered into, and attempted to be reared in, such obnoxious atmosphere. On the moral habits similar effects are produced; an inattention on the part of the local authorities to the state of the streets diminishes, year by year, the respectability of their occupiers. None dwell in such localities but those to whom propinquity to employment is absolutely essential. Those who might advocate a better state of things depart; and of those who remain, the one-half, by repeated exhibitions of indecency and vulgarity, and, indeed, by the mere fact of neighbourship, sink into the moral degradation which is natural to the other, and vicious habits and criminal propensities precede the death which these combinations prepare."

The Report, from which the above extract is made, abounds with valuable information on the condition of the working-classes of Leeds; and those who desire to pursue the subject will do well to peruse it, in connexion with the Report of the Town-council, published in the Statistical Journal for June, 1840.

From the woollen district, of which Leeds may be considered the representative, we shall desire the reader to accompany us to **Derby**, one of the principal seats of the silk and bobbin-net trade; and we shall find that here also the same causes—filth, crowding, and discomfort—lead to similar consequences. Derby, which has increased in population between 1831 and 1841 at the rate of about 48 per cent., is built on a flat close to the Derwent, which, as well as a tributary rivulet running through the heart of the town, is subject to considerable overflows in the wet seasons, and thus proves an important agent in producing fever and lung-disease among the working-classes during winter and spring. There are, also, as in all old towns, numerous courts and alleys, unpaved, insufficiently drained, abounding with ordure, and every other conceivable abomination, piled within half-a-dozen feet of the doors and windows, the entrance to these courts being by a narrow covered doorway, and their surface often below the level of the adjoining street. As respects the inhabitants, they are described as "dirty, reckless, and profligate; persons, whose irregularities and improvidence are keeping them in a state of perpetual ebb and flow between intemperance and destitution, and whose habits would be destructive to health even in situations the most salubrious,—persons who, by herding together, countenance each other in their faults, neither caring for the influence of good example, nor shamed out of what is reprehensible." Another cause of mischief is the habit of building single houses against other tenements, so that proper ventilation is absolutely impossible. Its fatal consequences may be abundantly seen in the Sub-registrars' returns of the deaths of 1841-2;—the inhabitants are always unhealthy, and constantly visited by epidemics and diseases of the digestive organs. The offensive state of the sewers in some parts of the town, and the disgraceful condition of the unfinished streets, are other circumstances powerfully co-operating to produce a surplus of disease; nor can there be a doubt that the needless—or to a great degree needless—smoke issuing from the factory chimneys, plays its part in making Derby, and other towns similarly situated, both disagreeable and unhealthy. Out of 100 deaths annually taking place in the Derby district, 28·6 are by epidemics (7·7 by typhus, and 21·7 by the epidemics peculiar to children), 23·8 by pulmonary phthisis, and 11·4 by inflammation of the lungs. The average mortality of Derby district is apparently low (only 1 in 40·3); but, like many other registration districts, it includes a considerable portion of rural population.

Birmingham, the great seat of the toy and trinket trade, and competing with Sheffield in the hardware manufacture, is furnished by its position on a slope falling towards the Rea, with a very good natural drainage, which is much promoted by the porous nature of the sand and gravel, of which the adjacent high grounds are mainly composed. The principal streets, therefore, are well drained by covered sewers; but still in the older parts of the town there are many inferior streets and courts, which are dirty and neglected, filled with stagnant water and heaps of refuse. The courts of Birmingham are very numerous in every direction, exceeding 2,000, and comprising the residence of a large portion of the working-classes. They are for the most part narrow, filthy, ill-ventilated, and badly drained, containing from eight to twenty houses each, the houses being usually three stories high, and often merely *single*, that is, built against some other tenement, and the end of the courts being pretty constantly occupied by ash-pits, &c., the filth of which would defy description. It is but just, however, to remark that the courts of more modern date are built in a more rational manner, and kept tolerably respectable; and the cottages, even in courts, are far less crowded than in Manchester and Liverpool, the result of which is, that the inhabitants, in epidemic seasons, have been much less visited by death than those of Wolverhampton, Dudley, and Bilston, at only a few miles distance. Cellar-residences, also, are unknown in Birmingham, though some few are, very improperly, used as workshops. The low lodging-houses are pretty numerous (somewhat exceeding 400), chiefly in courts near the centre of the town; they are almost always loathsomely filthy and close, the resorts of beggars, trampers, thieves, and prostitutes, who here, regardless alike of decency or comfort, eat, drink, smoke and sleep in an atmosphere unendurable by all except the degraded, besotted inmates. In such places as these small-pox, scarlatina, low continued fever, inflammation of the lungs, bronchitis and pulmonary phthisis, carry off about 1 in 24 yearly: and it is rarely, indeed, that, in the lowest districts, as Slaney-street, Steel-house-lane, and similar localities, one sees a person whose age may exceed fifty,—so baneful are the effects of the miasmatic influence exerted on the vital energies. Typhus, however, in its true form, is rare in Birmingham, causing a mortality of only 4·3 per cent., while the deaths from eruptive fevers, generally, are 14 per cent. of the whole mortality. The mortality of infants is high,—exceeding 32 per cent.; and of those who die every year about one-third are carried off by lung-diseases—chiefly tubercular consumption and inflammation (pneumonia). On the whole, Birmingham is less unhealthy than might be supposed from the kinds of occupation in which about 67 per cent. of its population are engaged; but there still remain numerous glaring evils, the reform of which will unquestionably lessen the number of the dying, and add to the vigour and happiness of the living population.

We have at no small expense of labour drawn up a table, from which the reader may determine at once the comparative healthiness of *five* different districts, compared with that of England and Wales,—the deaths at different ages being computed out of 100 born.

Table shewing the Deaths per cent. of 100 *persons born—under* 1 *year, and in nineteen periods of five years—in four City-districts and one group of Country-districts in England and Wales.*

Age.	Liverpool and Manchester	Leeds and suburbs.	Birmingham.	Metropolis	England and Wales.	Eastern and South-Western.
Under 1 year	25·05	25·4	24·42	19.22	21·7	19·99
1 to 3	19·28	17·77	16·02	15.13	12·81	10·78
3 — 5	6·59	6 08	6·78	6·19	5·21	4·85
5 — 10	1·76	5·34	5 91	4·90	4·88	5·08
10 — 15	1·94	3·09	2·28	1·74	2·67	2·86
15 — 20	2·58	3·73	3·03	2·26	3·50	3·52
20 — 25	3.57	3·79	3·17	3·37	4·09	4·17
25 — 30	3·72	3·35	3·47	3·65	3·73	3 53
30 — 35	3·82	3·39	3·56	3·92	3·42	3·09
35 — 40	3·79	3·31	3·44	4·34	3·31	2·97
40 — 45	3·63	3·13	3·48	4·37	9·48	2·66
45 — 50	3·32	2·53	3·65	4·14	3.07	2·95
50 — 55	3·11	2·63	3·30	3·04	3.07	3·05
55 — 60	2·66	2 90	2·95	3·78	3·14	3·15
60 — 65	3·06	2·93	3·33	4·45	3·93	4·23
65 — 70	3·60	3·15	3·15	4·08	4·05	4·62
70 — 75	3·33	2·81	2·97	3·90	4·30	5·26
75 — 80	2·44	1·87	2·57	3·18	4·11	5·46
80 — 85	1·99	1·41	1·52	1·88	3·07	5·03
85 — 90	·47	·66	·79	1·02	2·28	3·12
90 and upwards	·38	·21	·36	·38	·79	1·56

The above Table refers to the *deaths only*, and cannot, therefore, be taken as a basis for ascertaining the expectation of life (which is the point required by insurance and benefit societies); but it shows quite clearly the general fact, that life has different values in different places,—is more extended at Birmingham than in Liverpool, and more so in the eastern and south-western counties than at either. It may be asked, however, whether the surplus mortality of towns does not retard the increase of the people, and thus correct the pressure of the population on the means of subsistence. Certainly not:—for it is a well-ascertained fact (proved by the statistics of every country of Europe, and even of Mexico), that *the proportion of births to the population is always the greatest where there is the greatest mortality,*—in fact, that in those populations in which (to use the words of the Genevese calculator, M. Mallet, "the influences on the lower ages are absolutely murderous, the great mortality in infancy is compensated by a high degree." We shall exhibit this fact, as affecting different districts of Leeds and Manchester districts; and these may serve as examples of a general law of population.

Districts of Leeds Union.	Deaths to Population.	Births to Population.
Chapeltown . . . . (4,538) .	1 in 57·7	1 in 30·6
Whitkirk . . . . . (3,194) .	1 in 56·	1 in 29·
Kirkstall . . . . . (17,816) .	1 in 45·6	1 in 24·8
Rothwell . . . . . (5,557) .	1 in 45·1	1 in 28 2
Wortley . . . . . (16,185) .	1 in 44·4	1 in 24·9
Holbeck . . . . . (16,668) .	1 in 41·9	1 in 25·4
West Leeds . . . . (32,286) .	1 in 40·4	1 in 28·4
Hunslet . . . (15,784) .	1 in 35·5	1 in 24·2
North Leeds . . . . (30,465) .	1 in 30·9	1 in 23·9
Kirkgate . . . . . (24,862) .	1 in 28·8	1 in 24·3
Population . 167,355	1 in 37·8	1 in 25·5

Districts of Manchester.	Deaths to Population.	Births to Population.
Broughton	1 in 63·2	1 in 36·8
Cheetham and Crumpsall . . .	1 in 53·5	1 in 34·7
Pendleton	1 in 44·9	1 in 25.5
Chorlton on Medlock	1 in 38·5	1 in 25·
Hulme	1 in 37.9	1 in 23·2
Ardwick	1 in 35	1 in 24·3
Salford	1 in 31·4	1 in 22·8
Manchester	1 in 28·3	1 in 26·8
Population . 303,759	1 in 31·6	1 in 25·7

Neither words nor figures can more clearly shew the mysterious provision made for supplying the gaps in the human family made by the successful ravages of the "grim king of terrors;" but no provision can compensate for that loss of useful labour which might be expected from a population the majority of which should consist of persons in mature life and vigorous health. Indeed, Mr. Chadwick's remark is perfectly true,—"that to whatever extent the physical strength and probable duration of the working man's life are diminished by noxious agencies, to the same extent so much productive power is lost; and in the case of destitute widowhood and orphanage, burdens are created, and cast either on the industrious survivors belonging to the family, or on the contributors to the poor's-rates, during the whole period of the failure of such ability." (*Gen. San. Report*, 1842, p. 189.) With these facts no persons are more practically acquainted than recruiting officers, who invariably pick the most and the best of their soldiers from the rural districts: and it is well known to army-surgeons, that a corps levied from the agricultural districts of Wales, or the northern counties of England, will last considerably longer than one recruited in Manchester, Birmingham, Leeds, or London.

Before we close these descriptions of the sanitary condition of towns, it will be necessary to say a few words on Edinburgh and Glasgow—the leading towns of Scotland—and it will be plainly seen that gaunt misery is as familiar among our northern artizans as with our poorer brethren in the south. EDINBURGH has the reputation of being a beautiful and singularly well-placed city, so much so, indeed, that it has been termed "the modern Athens;" but this description applies principally to the New Town, which has been built less than a century, whereas the Old Town, which was built at different times, and originally within walls, consists of numerous closes or *wynds*, diverging from the High-street, and the houses are often so close together, that persons may step from the window of one house to that of the house opposite—so high, piled story after story with the view of saving room, that the light can scarcely penetrate to the court beneath. In this part of the town there are neither sewers nor any private conveniences whatever belonging to the dwellings; and hence the excrementitious and other refuse of at least 50,000 persons is, during the night, thrown into the gutters, causing (in spite of the scavengers' daily labors) an amount of solid filth and fœtid exhalation disgusting to both sight and smell, as well as exceedingly prejudicial to health. Can it be wondered that, in such localities, health, morals, and common decency should be at once neglected? No; all who know the private condition of the inhabitants will bear testimony to the immense amount of their disease, misery, and demoralisation. Society in these quarters has sunk to a state indescribably vile and wretched; and, as Mr. Chambers observes, in a letter to the poor-law commissioners, "they have gravitated to a point of wretchedness from which no efforts of the pulpit, the press, or the schoolmaster can raise them, for they are too deeply sunk in physical distress, and far too obtuse in their moral perceptions, to derive advantage from any such means of melioration." The dwellings of the poorer classes are generally very filthy, apparently never subjected to any cleaning process whatever, consisting, in most cases, of a single room, ill-ventilated and yet cold, owing to broken, ill-fitting windows, sometimes damp and partially under ground, and always scantily furnished and altogether comfortlesss, heaps of straw often serving for beds, in which a whole family—male and female, young and old—are huddled together in revolting confusion. The supplies of water are obtained only from the public pumps, and the trouble of procuring it of course favours the accumulation of all kinds of abominations. The result of such a state of things will be found by referring to Dr. ALISON's work on the "Management of the Poor in Scotland." It is there stated that, owing to the crowded and intolerably filthy state of the lodgings, the lanes and closes of the Old Town are scarcely ever free from malignant fever, and that in the city itself the mortality (1837-8) amounted to 4½ per cent. (1 in 22), almost equal to that of the plague-depopulated Constantinople. Such facts are quite appalling, and should rouse the authorities to exertion; nothing short of a pretty extensive demolition of the Old Town will stay the evil; and surely, if the lives of thousands are at stake, the consideration of property should not be allowed to retard the reform.

GLASGOW is a city, the appearance of which is in every way inferior to Edinburgh, and the fact of its being the seat of an extensive weaving industry would lead us, *à priori*, to conceive a proably high amount of destitution and unhealthy crowding of population. The climate is far from being unhealthy; the population in 1840 was estimated at 282,000, of whom *about 78 per cent. belong to the working clases*, 50,000 being Irish. Glasgow has its fine, airy, healthy quarters, that may vie with those of London and all wealthy cities; but it has others also which, in abject wretchedness, exceed the lowest purlieus of St. Giles' or Whitechapel, the liberties of Dublin, or the wynds of Edinburgh. Such localities exist most abundantly in the heart of the city—south of the Trongate and west of the Salt-market, as well as in the Calton, off the High-street, &c—endless labyrinths of narrow lanes or wynds, into which almost at every step débouche courts or closes, formed by old, ill-ventilated, towering houses crumbling to decay, destitute of water and crowded with inhabitants, comprising three or four families (perhaps twenty persons) on each flat, and sometimes each flat let out in lodgings that confine—we dare not say accommodate—from fifteen to twenty persons in a single room. These districts are occupied by the poorest, most depraved, and most worthless portion of the population, and they may be considered as the fruitful source of those pestilential fevers which thence spread their destructive ravages over the whole of Glasgow. Fluctuations of trades and low rates of wages no doubt contribute a principal portion of the misery, which is nearly doubled by a reckless addiction to the use of ardent spirits, which are here so cheap (4½d. the half pint) as to be drunk almost as copiously as porter is swallowed by the English, and give rise to an incredible number of whisky-shops. We incline to think, however, that, if the domestic comforts of the poor were increased by sanitary regulations, the dram-shops would be far less patronised and gradually annihilated, and men would not be found loitering and besotting themselves in the whisky-houses to avoid the harrowing, depressing sights of domestic misery. Dr. Cowan's book on the "Vital Statistics of Glasgow" is in every way worthy of attentive study, and shows a great surplus amount of typhus, low, continued fever, bowel diseases, and diseases of the lungs, by all of which, but principally the first, the whole population is carried off at the rate of 1 in 31, while the working poor—a stunted, starveling, puny, dissipated-looking race—are killed off at the fearfully rapid rate of 1 in 24, life at birth to these classes being worth scarcely more than twenty years' purchase.

Enough—and more than enough—of such startling, sickening details. We propose, on a future occasion, to point out the remedies for such fearful evils: *first*, those which each working man can apply for himself without interference from law or town authorities; *secondly*, those which must flow out of some general act of the legislature that shall affect retrospectively and prospectively every town in the British Empire.

Art. V.—THE "ARTIZAN" PLAN FOR WORKING STEAM ENGINES WITHOUT FUEL.

Many of our readers will look upon the title of this article with the eye of a sceptic. Engineers, in particular, will exclaim that the thing is impossible—that it is like producing an effect without a cause, and that such a project stands in the same category as the schemes for perpetual motion. Softly, ye Solons in iron, say we,—you forget two things: first, that it is the *Artizan* that makes the announcement; and, second, that there are many things in this wide world not dreamt of in *your* philosophy.

But to the point. It is obvious to all that in the operation of a condensing steam-engine, the whole heat generated by the boiler ultimately goes away in the form of hot water, delivered by the air-pump. In this hot water, however, the heat is in a diffused state, but it is there, nevertheless, in undiminished quantity; and it is only necessary to concentrate this heat—not to produce it out of nothing—in order to make it available for again raising steam to work the engine. If this were done, the heat would circulate through the engine in a manner analogous to that in which the feed-water circulates in the case of external condensation: it would pass to a regenerator, or rather a concentrator, to be made available to keep up the heat in the boiler, just as the steam passes into the condenser to be turned into water for keeping up the feed. The concentrator would return the heat, as the condenser returns the water; and such an engine would work without fuel, except the small quantity requisite to cover the loss by waste and radiation. The whole matter, therefore, resolves itself into this,—can heat be concentrated? In other words, can a large quantity of heat of a low intensity, be turned into a small quantity of a high intensity? To this we answer, that it can; and to give a familiar example,—the thing is accomplished by every burning-glass and concave mirror. The question, therefore, is, how may the principle of concentration be practised, so as to produce a practical result?

It is known to most of our readers, that when a bar of metal is unequally heated, electricity is developed, which, from the mode of its excitation, is called thermo-electricity. Different metals yield different quantities of electricity, with the same extremes of temperature; but alternate bars of antimony and bismuth appear to be more effectual in awakening this electricity than any other combination. A number of antimony and bismuth bars, arranged in the fashion of a faggot, and heated at the one end and cooled at the other, will yield large quantities of electricity, with a very trifling difference in the temperature of the two ends; and as electricity in large quantity produces intense heat, a temperature far exceeding the temperature of the hot end of the faggot is obtainable by means of this instrument. Here, then, we have a heat-reproducer, which may be rendered available for the uses of the steam-engine. A thermo-electric combination may be adapted, in which the hot water of the air-pump, or rather the steam in the act of condensation, is made the heating agent, a stream of cold water being made the cooling one; and the electricity thus developed may be applied to keep up the steam without the aid of a fire.

These views are not merely hypothetical, for Our Club has instituted several experiments on the subject, and, by means of warm water, has developed sufficient electricity to make iron red hot. The arrangement adopted in this case, was a succession of cells, composed of bismuth and antimony plates, with cold water on the one side of each alternate plate, and hot water on the other. Each plate thus became, in effect, a very short and very thick bar, and the whole of these bars were connected together, as in the case of ordinary thermo-electric batteries. A ribbon coil and ratchet wheel, for breaking and re-forming the connexion, were also employed, without which the same degree of intensity would not have been obtained.

This explanation is sufficient, we conceive, to show the feasibility of the project, and will probably convince the most sceptical that heat, after having performed its function in giving motion to a steam-engine, may be brought back, from the point at which it started, to again go through the same gyration. There is one point, however, yet in doubt, and that is whether the whole of the heat would thus be got back? Upon this point the experiments of the Club throw no light: they merely shew that heat may be got back in this way, but whether the greater part only, or whether the whole, is a point still in obscurity. The resolution of this doubt, and the determination of the most commodious arrangement for carrying out the principle in practice, they surrender to the ingenuity of the readers of the *Artizan*, as they conceive they have done their part in shewing the feasibility of so important a project, and pointing out the means by which it may be brought to bear.

It is of course obvious to every reader that this method of producing power by the agency of electricity is different in principle from all the electro-motive expedients hitherto brought forward, inasmuch as here there is no waste of anything in sustaining the electric power. It is to little purpose that an engine can be worked by galvanism or electricity if the expense of producing that galvanism or electricity is greater than that of producing the same power by more vulgar modes; and in ordinary galvanic arrangements the waste of copper and zinc in the plates of the battery involves a greater expense than the expenditure of fuel in the production of an equal power. If metal be wasted, or mechanical power, or anything in short as expensive in the production as coal, there is obviously no advantage gained by an exchange, and although such a scheme may serve as a nine days' wonder it can never come into practice. It is idle to waste thought on any such playthings as these, but a project which pretends to the accomplishment of all that a steam-engine can do, without any expense at all, is worthy of a graver consideration, unless, indeed, it bear upon its front the mark of absurdity, and by this badge, it is scarcely necessary to add, the present scheme is undistinguished. Entertaining as we do the fullest conviction of its feasibility and moment, we cannot hesitate to commend its prosecution of the inquiry to all ingenious persons who have time and opportunity for experimental researches.

We may here announce that it is our intention to take every opportunity of laying before our readers an account of such projects as it is desirable to accomplish, and to indicate generally and briefly the manner in which their realisation may be effected. By thus presenting to the ingenious a suitable material to operate upon, and, at the same time, rough hewing it into shape so as to give the general contour, a large proportion of the talent now wasted on fantasies, or in re-inventing things already perfected, will be turned into a profitable channel and add energy to the current of improvement. The ingenuity diffused among the class to which our pages are addressed is inconceivable, but the greater proportion of it is now dissipated in fruitless schemes arising out of imperfect information, or arrested in its growth by the discouragements consequent on circumstances so unhappy. The *Artizan* intends to put an end to these evils by specifying the things it is desirable to accomplish, and the general principles which must be kept in view, leaving to individual ingenuity the contrivance of the means necessary to work out the idea in practice.

Art. VI.—A FEW WORDS ON THE TRADES OF BIRMINGHAM.

Birmingham,—situated in the midst of an undulating country of the new red-sandstone formation (varied here and there by patches of diluvial clay), close to the summit-level, or watershed (460 feet above the sea), that separates the tributaries of the Trent from those of the Severn, and built on the slopes of low hills, falling towards the Rea, a remote branch of the former river,—boasts of an antiquity long prior to the Norman invasion, at which time we find it in Domesday-book called *Bermengcham*, a name which it preserved till Edward VI., in the slightly altered appellation of *Brymyncham**, which we regard as the origin of its now vulgar name, *Brumy'cham*, or *Brumycham*. The early history of its present manufactures is involved in obscurity; but in the reign of Henry VIII. it is described as "a good market-town," the residence of "smithes that use to make knives and all manner of cutting tooles; lorimers that make bittes and a great many nailowrs" (*Leland's Itinerary*); and about a century later we find it supplying 15,000 sword-blades to the troops of the Parliament, whose cause it warmly espoused against Charles I. and his nephew

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* See charter of the grammar-school, granted by Edward VI.

Prince Rupert. Bishop Gibson, in his edition of "Camden's Britannia," dated 1722, remarks that "most of the inhabitants be smithes and other artificers in steel and iron, whose performances in that way are greatly prized both at home and abroad." Twenty years later the manufacture of brass goods was introduced, and carried to some perfection by JOHN TAYLOR, a celebrated brass-founder, to whom we owe the invention, or improvement, of the stamp and press. The art of japanning, both on metal and *papier maché*, was introduced about the same time by JOHN BASKERVILLE, to whose inventive genius, also, we owe improvements in type-founding and printing that raised him to the dignity of a second *Caxton;* and in 1764 were opened the far-famed Soho Works, a vast manufacturing dêpot, brought to perfection by the united talents of MATTHEW BOULTON and JAMES WATT, under whose superintendence it sent forth almost every conceivable metallic commodity, from the copper penny of the realm, and innumerable articles of plate, bronze, and brass, to the ponderous steam-engine, now brought to such perfection as to be capable of supplying the place of hundreds of human labourers, of thereby meeting the demands of almost every market in the world, and consequently diffusing over every nation with which we are connected the inestimable blessings of comfort and civilization. To describe the process by which Birmingham has increased its productive powers during the last fifty years would occupy more space than consists with our limits; suffice it here to say, that the practically-scientific genius that has long characterised English mechanicians, has here, as at Sheffield, been actively at work, inventing, applying, modifying, and improving various mechanical contrivances; the whole town and its neighbourhood have long been the scene of enterprising, persevering, constantly increasing industry; and now (with the exception of slight occasional stagnations, caused partly by over-speculation, but principally by illiberal laws affecting foreign trade) wealth, the reward of successful labour, has for years been flowing in from all sides in a large, rapid, and bounteous current.

We purpose giving some particulars of the *leading* trades carried on at Birmingham; but we first present a list of such as we have been able to separate into distinct classes, premising, that it is far, perhaps *very far*, from including the endless ramifications into which the businesses are divided.*

Gold, Silver, Gilt, and Plated Goods.—Jewellers and gilt toy makers, watch chain, key, and gold hand manufacturers, gilt ring and seal makers, army and gilt button makers, ring turners, medal and coin makers, bright engravers, sword hilt makers, toy burnishers, filigree workers, plated snuffer chasers, pencil case and toothpick makers, makers of silver and plated spoons, knives, forks, teapots, plates, sugar-basins; chain makers, thimble stampers, stampers and piercers, pencil case makers, &c. &c.

Iron and Steel Goods.—1. Fire irons and swords, gun and pistol makers, gun makers, gun lock and furniture filers, stockers and stock sinkers, gun polishers, gun charger and furniture makers, bayonet-case and powder-flask makers, ramrod makers, bayonet cutlers, sword cutlers, scabbard makers, &c.

2. *Tools.*—Die sinkers, engine cutters, saw-tool, vice, hammer, plane, auger, awl-blade, gimblet, and other tool makers, smiths' bellow's-pipe makers, screw-plate workers, coach-spring makers, braziers' tool makers, scythe, sickle, and spade makers, &c. &c.

3. *Other Iron Hardware.*—Makers of bits, stirrups, curbs, bridles, spurs, spur rowels, cock heels, horse and dog collars, fetters and dog locks, dog and cart chains, nails, sprigs, tacks, screws, scale beams, steel chains and toys, ferrules, patten rings, forks, iron spoons, snuffers, thimbles, inkstands, steel keys, mouse traps, spring latchets, mortices and other locks, pendants, hinges, pin makers, warming pans, fire irons, cruet frames, corkscrews, gridirons, buckle ring forgers, and buckle chasers, &c. &c.

Brass and Mixed Metals.—Brass-founders, sadlers' brass-founders, lamp makers, makers of candelabra, tea-urns, white metal teapots, albata spoons, forks, and other domestic furniture, albata pencil case makers, button and button shank makers, and button soldering, brass nailers, pocket locksmiths, brass moulders, gas ornament designers and moulders, gas-pipe drawers, gas tap makers, and other gas fitters, brass cock workers, iron and brass wire drawers, coach-harness forgers, bed and coach screw makers, printers' typefounders, malleable zinc plates, clock hand, coffin nail, lead toys, and match box makers, &c. &c.

Miscellaneous.—Glass blowers, looking-glass makers, glass stainers, makers and grinders of watch and optical glasses, glass moulders, makers of glass beads and doll eyes, glass seal makers, glass button makers, glass house moulders, and casting mould makers, japan wares, &c. Bone, ivory, tortoiseshell, and pearl-box makers, paper spectacle-case makers, comb and spectacle-frame makers, pearl button turners and cutters, papier-maché moulders and japanners, umbrella makers, putty and varnish makers, hand-whip mounters, fish-rod, line, and tackle makers, air-pump and machine makers, smoke-jack makers, &c. &c. &c.

Among these multifarious occupations—estimated before the House of Commons, in 1825, at *two hundred*, each quite separate from its neighbour—we select only a few for particular description, and shall then make some remarks on the workshops' general condition and average wages of the work-people.

1. *Gun Making and its Branches.*—This manufacture, at once the oldest and most important of those carried on in Birmingham, was introduced at the beginning of the last century; since which time it has gradually, but so immensely increased, that Birmingham may now be termed the great emporium of the world for all destructive weapons, including muskets, pistols, and fowling pieces. During the last war, the government contract for muskets alone averaged 30,000 per month; and in the fifteen years between 1804 and the termination of the war, Birmingham furnished upwards of *five millions of fire-arms!* The number manufactured in the next fifteen years (1814—1828) was estimated at three millions, and the demand for these articles up to the present time is perhaps less fluctuating than for any other product of industry. A proof-house has been established by Act of Parliament, where the excellence or imperfection of all gun and pistol barrels is proved by a heavy charge determined by the Board of Ordnance. If they stand this test they are marked by a stamp, to counterfeit which is felony, and the sale of unstamped guns is punishable by a heavy fine. The manufacture of swords may also be regarded as one of the staple trades of Birmingham, but since the peace it has much declined.

2.—*Gold and Gilt Toys.*—The toy and trinket trade in its various ramifications is so immense, that surely Mr. Burke was not far wrong in designating Birmingham as "the toy shop of Europe." Vast quantities of beautiful articles, fancy seals, brooches, clasps, rings, and innumerable other trinkets, are made of gold, silver, gilt, and plated metal, mosaic gold, and other alloys, as well as of polished steel and iron, the workmanship being by aid of the stamp, the press, the lathe, the draw-bench, and other ingenious mechanical contrivances, of a quality often combining beauty of appearance and solidity of texture with an extraordinary lowness of price. The impressions on glass seals, made to imitate engravings on stone, which would themselves cost thirty shillings, are admirably executed at 1½d. each, their production giving employment to some hundreds of hands, chiefly women and children.

3. *Button and Buckle Making.*—To the invention and manufacture of these articles Birmingham may lay undoubted claim, inasmuch as it has witnessed all its fluctuations, from the small iron plain buckle, and the horn button covered with metallic foil, through all the innumerable and capricious varieties of shape and embellishment which prevailed when gentlemen wore powder and bob wigs, looped hats, embroidered coats and swords, and through the still more fantastic, quickly-varying changes of fashion required for the foreign markets. The boot and the shoe tie have now entirely supplanted the shoe buckle, the use of trousers also rendering the knee buckle wholly needless; the trade of the buckle maker is now, therefore, confined to few hands, chiefly for ladies' wear, and thousands who once depended on it for support have turned their industry into more profitable and useful channels. The manufacture of buttons, however, is still most extensively carried on, and is divided into many branches, according as the article is of metal, wire, or bone, as well as into several departments, stamping, gilding, burnishing, chasing, shank-making, &c. The machine used for making button shanks is one of the most ingenious that Birmingham furnishes, a single revolution of the machine sufficing to cut the required length from the wire, to bend it into its proper curves, and so flatten the extremities as to prepare them for being soldered on the surface of the button. The fashion of buttons is now for the most part plain or slightly raised; and the art of gilding, which within the last few years has been called into much greater requisition for fancy buttons than for some years before, is carried to such perfection, that three or four pennyworth of gold is said to be sufficient for gilding a gross of buttons. The immensity of this apparently trifling business may be conjectured from the fact that the leading manufacturers keep each from 10,000 to 12,000 different sets of cut steel dies for livery, military, and club buttons!

4. *Gold and Silver Plating, and Albata Goods.*—Birmingham, though inferior to Sheffield in the value and magnitude of this manufacture, enjoys a high reputation for the beauty and variety of its plated goods, and so long back as 1772, wardens, and an assay-master, were appointed by Act of Parliament for superintending the trade, and stamping all silver articles weighing more than five pennyweights. The quantity of silver used in these manufacturers—*i. e.*, in the plating of spoons, knives, forks, plates, dishes, breadbaskets, candlesticks, &c., cannot be much less than 40,000 ounces a-year, while the consumption of the same metal for pencil cases and trinkets may average about 100,000 ounces. The quantity of silver plate made here is comparatively insignificant, having been estimated at 121,400 ounces

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* ADAM SMITH, in his "Wealth of Nations," has a long chapter on the *principle* giving rise to the division of labour, and, perhaps, in the whole work there is no instance to be found of reasoning so weak and inconclusive. Far more solid is the argument of his disciple MC CULLOCH, who states that "the division in question is plainly a consequence of our being enabled to perceive, or at all events to conjecture, with more or less accuracy, what is, under any given circumstances, most advantageous or useful to ourselves." *Innate propensities* (to which A. Smith attributes this division) exist in none, savage or civilised, towards any particular line of conduct; but one man may have physical powers or mental talents and disposition leading him to employments widely different from those pursued by his fellow man, and nothing can be more natural than that each one should apply himself in preference to those occupations that he reckons *most beneficial to himself*, being content to exchange such of his own produce *exceeding his consumption* as may be held equivalent to the produce of others that he may wish to obtain. This statement forms *one* great basis of political economy—a science founded on pure common sense, and flowing out of natural, self-evident, incontrovertible principles; alas! grossly neglected—nay, even ridiculed—by the majority of our legislators, or at the least its truths sought to be glossed over by some disingenuous pretext.

in 1837. The whole of this business, however, has received a great and, we suppose a fatal check, by the introduction of albata metal, which from its superior durability to plated goods, as well as its extreme resemblance to silver, has become so extensively introduced into families as almost to supersede the use of spoons, knives, and forks, either of silver or plated on steel, which had hitherto been made in large quantities. The albata is a compound of tin, the regulus of antimony, copper, and brass; the articles made of it are extremely cheap, beautifully wrought, and, when care is taken to purchase those that are sufficiently massive, they are very durable and have a handsome appearance. The stamp and press are extensively used in these manufactures, aided by the chasing tool and hammer for ornaments in relief.

5. *Japanning.*—Japanned articles of great beauty and variety are very extensively manufactured. The art had a very humble origin with tobacco boxes, small trays, and various insignificant articles; but Taylor and Baskerville—the former by painting, the latter by introducing the *papier-mâché* —raised it to a degree of excellence before unknown. Great talent is now called forth, and some of the best painters of the country have been engaged in the earlier part of their career in painting the teaboards and waiters of Birmingham. These articles are susceptible of great elegance, and, when produced in perfection, are beautiful specimens of the painter's art. The coarser, and, consequently, the more extensively conducted branches of the trade, are carried on at Bilston and Wolverhampton.

6. *Steel Pen Making.*—This branch of industry has sprung up in Birmingham, as well as at Sheffield, within the last twelve or fifteen years, and so greatly has the manufacture increased and risen in perfection, that while the article has been constantly improving, the price has been perpetually on the decrease, so that at present the best *three-slit* pens may be purchased at 8d. the gross, commoner articles being made at a still lower price. It has been calculated that about 800,000 gross, or nearly *ten millions* of steel-pens, are annually made in Birmingham *only*, employing about 600 persons, and consuming about 80 tons of fine sheet steel!

7. *Nail Making.*—The use of machinery in making screws and nails has been introduced with great success—well-formed nails being cut out of sheet-iron far more rapidly than the human hand could snip paper with scissors—and, after being thus cut, receiving, by powerful pressure, well-formed heads, while, at the same time, a novel process of annealing gives them a tenacity almost equal to that of nails forged by the hammer. The Britannia Nail-works are provided with machinery producing several thousands of nails each minute. Nothwithstanding, however, the relief offered to human labour—perhaps the most slavish in the hardware branches—nails are still made very extensively by hand in and about Dudley, Walsall, and Stourbridge, employing from 30 to 40,000 persons, chiefly women and children, at the nail-block, earning wages barely sufficient to maintain life.

8. *Glass Making.*—This branch of industry has long been carried on in this and adjacent towns. The largest manufactory of crown glass is that of Messrs. Chance and Hartly, near Birmingham, where there are also considerable manufactories of flint and other descriptions of glass, the quantity made in this revenue-district averaging about one quarter of the whole duty collected in England. The business is not now confined in its higher branches to cut decanters and other domestic vessels, nor to ornamental chandelier-drops; but the melted metal is cast into scrolls, foliage, and various figures of small size, with a degree of boldness hitherto unknown, while from the lathe and the cutting-tool it derives a sharpness of edge and smoothness of surface that give to it a delicacy and brilliancy not attainable by other methods.

To detail, however, or even to attempt a general description of the various manufactures that have owed their origin during the last half century to the facilities afforded by the newly created mechanical forces, and the various branches that have arisen out of the division of labour, comprising, not merely artizans, but also artists, chemists, and other men of science, would far exceed our limits. Birmingham has now nearly 150 steam-engines of an aggregate power of 3,000 horses. In addition to which the stamp, the press, the lathe, the draw-bench, and other mechanical contrivances, have multiplied the facilities of manufacture to an almost incalculable extent. With respect to the value of the Birmingham manufactures, Mr. McCulloch states that there are no means of estimating the total value of the articles produced, owing to the confusion in the returns of goods produced here with those made at Sheffield; the value of the articles made here, however, including gold and silver plate, does not fall far short of *three millions* sterling, the value of the material in most of them bearing but a very small proportion to that of the labour expended on them; as, for instance, in watch-springs the value of the raw material is not 1-200,000th part of the value of the finished article. Indeed, *it is from this extreme sub-division of employment that the superior skill of the workman and the excellence of the manufacture are mainly deducible.*—(See *Geog. Dict.*, vol. I, page 382. Art. Birmingham).

Workshops and Workpeople.—Birmingham has a few, and few only, manufacturers employing large capitals in their business, most of them having only very limited capitals, and many of them being only agents or middle-men, Mr. Porter, of the Board of Trade, has admirably described the usual mode of conducting the business:—" Almost all the small wares of the district are made by workmen who undertake, each one in his particular line, to execute orders received by the merchants and agents settled in the town. The profitable performance of their contract, however, calls for the employment of a cheaper kind of power than is at the command of men who, like these workmen, have little or no capital; and this course of business has opened here, as well as at Sheffield, a channel for the employment of money in the town, at once profitable to those who engage in it and advantageous to the small manufacturer. The plan alluded to is this. A building, containing a great number of rooms of various sizes, is furnished with a steam-engine, working shafts from which are placed in each apartment or workshop, which is likewise furnished with a lathe, benches, and such other conveniences as are suited to various of the branches of manufacture for which the rooms are likely to be needed. When a workman has received an order for the supply of such a quantity of goods as will occupy him a week, or a month, or any other given time for their completion, he hires one or more of these rooms of sizes and conveniences suited to his particular wants, stipulating for the use of a certain amount of steam power. He thus realises all the advantages that would accompany the possession of a steam-engine; and as the buildings thus fitted-up are numerous, competition on the part of their owners has brought down the charge for the offered accommodation to the lowest rate that will ensure to them the ordinary rate of profit on the capital employed. Before the introduction of this system, the trade of Birmingham was for the most part carried on by men of large capital, who employed journeymen, and gave a considerable credit to the merchants who dealt with them. At present, those merchants themselves employ the workmen, who can give no credit, but receive payment in ready money at the end of every week for such part of their goods as they can deliver in a finished state; and in this way the profit of the intermediate dealer is saved." (*Progress of the Nation, vol.* I, *page* 299.) A considerable number of children, probably between 3,000 and 4,000, under eighteen years, are employed in the manufacturing processes chiefly in the houses of the artizans, many of whom, from living in top-stories, are called *garret-men*, employing a number of boys in close rooms, very detrimental to their health. The trades in which children are principally used comprise brass casting, the "cobbing" in metal-button making, polishing, burnishing, and packing metal goods, waiting on the men, running errands, &c. &c. With respect to wages, it is extremely difficult to draw an *average* where the rates vary from 70s. to 21s., according to the skill of the workman or the demand for the article, but we shall, perhaps, not be much in error when we estimate them at 25s. for men above twenty; women earning about 10s., and the children from 6s. to 9s. weekly. The dwelling of the working-classes are on the whole much more respectable, as well as wholesome, than those occupied by the same people in other manufacturing towns; and we have reason to believe that, on the score of morals, they will not suffer in comparison with the workpeople of Sheffield or the metropolis, although much has been said in their disparagement by persons writing with a political bias.

With respect to the salubrity of the various trades, it is affirmed by the physicians of the town (See *Local Sanitary Report*, vol. I, p. 216) that only a few of the manufacturing processes—for instance, of white-lead, gilding, dry grinding, brass-founding, lackering, and pearl-button making—exert any specific baneful influence on the animal economy. In fact, more evil consequences to health arise from the workshops than from the processes carried on in them. They are generally too small, frequently damp and badly glazed, almost always—even in the larger manufactories—imperfectly warmed and ventilated, suffocatingly hot in summer, and intolerably cold in winter; a condition so positively injurious to health and life, as to demand interference of the legislature for their proper regulation in these respects.

The above observations on the trades of Birmingham have been given, partly from private inquiries in the town, and partly on the authority of published records, including (besides the works already quoted) Mr. Hawke Smith's edition of Hutton's Birmingham, the Treatise on the Metallic Manufactures, and Lardner's Cyclopædia, and an admirable article on the same town in the *Penny Cyclopædia*, drawn up on the spot. It is believed, therefore, that our description may be regarded as both authentic and *recent* on all points of material importance.

Art. VII.—DIRECT ACTION MARINE ENGINES.

We intended to have given, in the present number, an analysis of the qualities of the several marine engines figured in the large plate we have this month given away. But we find that we have neither time nor space to accomplish the task satisfactorily; and we must, therefore, postpone our intention until next month. The work, it is needless to say, is a delicate and invidious one, and we should be loth to say anything to the praise or blame of particular plans without mature consideration. Next month, however, we shall be prepared to say all that we have to say on the subject.

Art. VIII.—THE BUILDING ARTS.

GEOMETRICAL SOLIDS.

In addition to the solids detailed in our last number, we may enumerate the Cone, the Cuncus, and the Cylindric Ring.—The Cone, as every one knows, is a solid with a circular base, and its top terminating in a point, so that it may be said to be a round pyramid. Its sections are five in number, viz., the triangle, the circle, the ellipse, the parabola, and the hyperbola.

Thus if a cone be cut by a plane passing through the centre of its base and the vertex, the section is a triangle; if cut by a plane parallel to the base, the section is a circle; if, as in fig. 8, the cutting plane pass obliquely to the base, in such a direction as to cut through the opposite sides of the cone, the section is an ellipse; if, as in fig. 9, the cutting plane pass through the solid, parallel to one of its slanting sides, the section is a parabola; and if, as in fig. 10, the plane passes through the solid in a direction which, if produced, will intersect but one of its slanting sides, without being parallel to either, the section is a hyperbola.

Fig. 8.

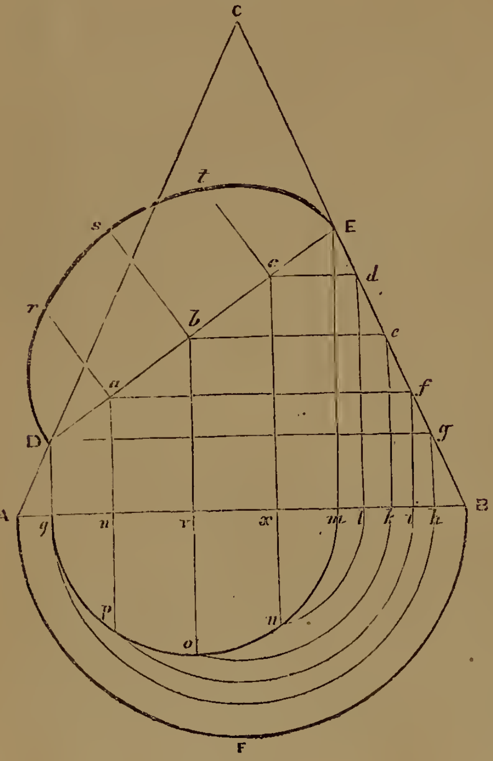


Fig. 9.

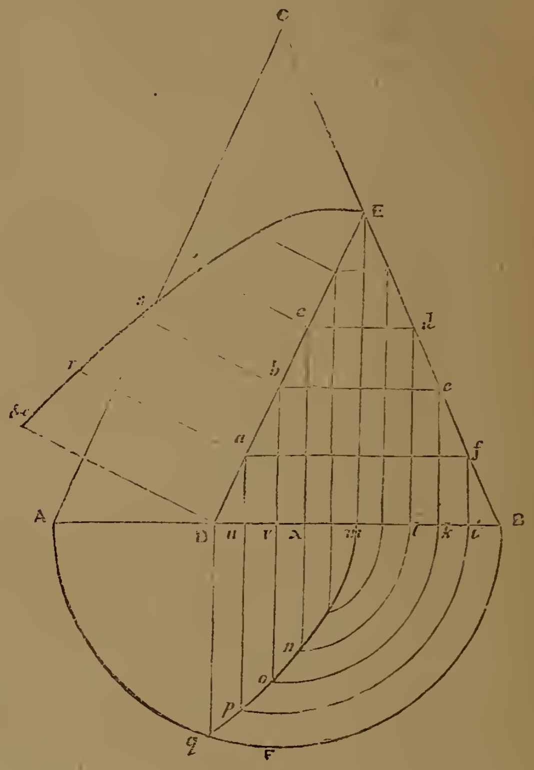
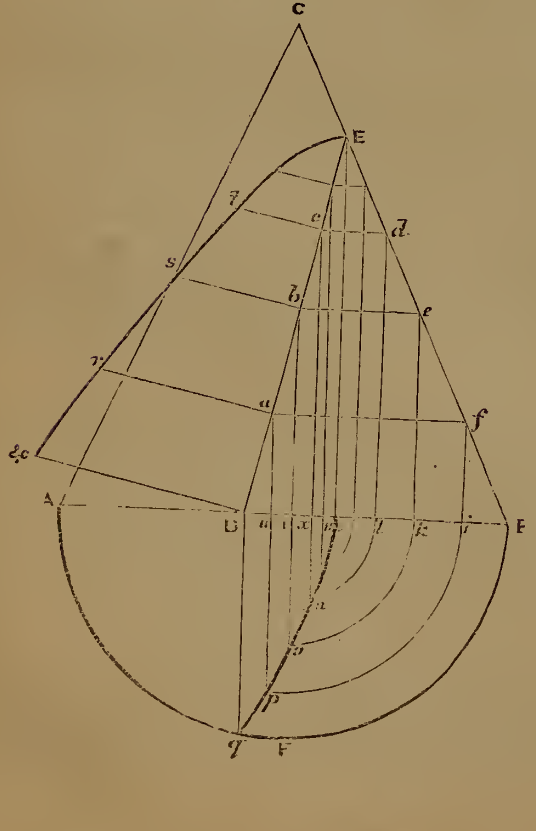


Fig. 10.



In the figures 8, 9, and 10, let A B C represent the slanting sides of the cone; A B F the half of its base; and D E the cutting plane of its sections. Then, in order to find the boundary line of each section, draw any number of lines *a f*, *b e*, *c d*, &c., parallel to the base line A B; from the points *f e d* let fall the perpendicular lines *f i*, *e k*, *d l*, &c.; from the centre of the base describe the arcs *i p*, *k o*, *l n*, &c., cutting the perpendicular lines *a u p*, *b v o*, *c x n*, &c., in the points *n o p*. Draw the ordinates *a r*, *b s*, *c t*, &c., perpendicular to the line D E; make *a r* equal to *u p*, *b s* equal to *v o*, *t c* equal to *x n*, &c., and through the points E *t s r*, &c., draw the curve line which is the boundary of the section of the cone.

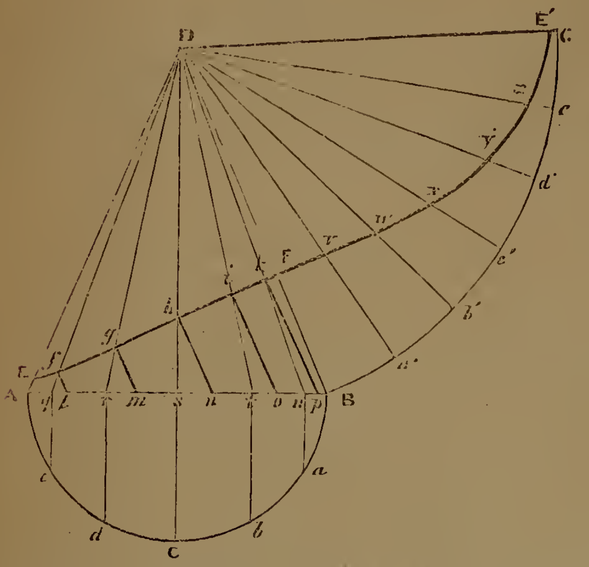
It will be observed that the lines *a f*, *b e*, *c d*, &c., are conceived to represent sections of the cone cut parallel to the base, intersecting the oblique sections in the lines *a r*, *b s*, *c t*, &c., these lines, or ordinates, being common to both surfaces of the cutting planes. The curved line *m n o p q*, as projected upon the plane of the base, is the seat of the boundary lines of the sections, formed by the cutting planes respectively of the elliptic, the parabolic, and hyperbolic curves.

The principles laid down in the foregoing examples, are applicable in ascertaining the sections of all other solids of a similar description; and we may here state that the result we have deduced may be arrived at by a more compendious, but at the same time a more superficial, process than is here adopted. We have given the preference, however, to the more tedious mode, because it conveys a knowledge of the principles, as well as a knowledge of the knack; and unless the principles are comprehended, the process is not likely to be remembered, nor can the artificer retain any confidence in his own judgment, where the case differs in the least from those which have occurred in his previous practice.

The development, or covering of the surface of a cone, is shown in fig. 11. Let A B C represent the base of a cone; A D and D B its slanting sides. Let it be required to find the covering for that portion of the cone shewn by the lines A F, A B. Divide the circle A C B into any number of equal parts, B *a b* C *d e* A; with the point D as a centre describe the arc B G; make the length of this arc exactly equal to the length of the semicircle A *e d* C *b a*; make each of the divisions thereon exactly equal to those of the semicircle. Draw the lines D *a'*, D *b'*, D *c'*, D *d'*, D *e'*. From the points *e d* C *b a* let fall the perpendiculars *c q*, *d r*, C *s*, *b t*, *a u*; and from the points *q r s t u* draw the lines *q* D, *r* D, *s* D, *t* D, and *u* D, cutting the line E F in the points *f g h i k*. Draw the lines *k p*, *i o*, *h n*, *g m* and *f l*, parallel to the line D B, cutting A B in the points *l m n o p*; make the distances *a' v*. *b' w*, *c' x*, *d' y*, *e' z*, and G E', respectively, equal to *k p*. *i o*,

hn, gm, fl and E A. Draw the curve E z y x w v F through the points thus ascertained, and the figure B F G E' is the development of the portion of the cone shewn by the lines A E F B, as required.

Fig. 11.



The forms of the conic solid, and its developed surfaces, are applicable to the construction of the arch stones in domes, the splayed arch heads in window or door openings, the covering of conical shaped roofs, and various other details frequently met with in buildings, as will be more particularly shewn forth in our working details, hereafter to be given.

The Cuneus Solid.—The Cuneus, or wedge, differs only from the cone by having its vertex terminating in a straight line, instead of a point, as in the cone. The description of this solid will be seen in fig. 12. A B F represents the end, or base; A C B the slanting sides, terminating in a straight line. The figure A' C' c' F' represents the side elevation of the cuneus. The figure G r H is a section on the G R, and I r K a section on the line I K; the mode of obtaining these sections is similar to that described in fig. 4, in our article on the Building Arts in the last number of the *Artizan*, with this exception, that the lines hp, iq, kr, &c., are made to converge towards the apex of the cuneus, as shewn in the figure.

Fig. 12.

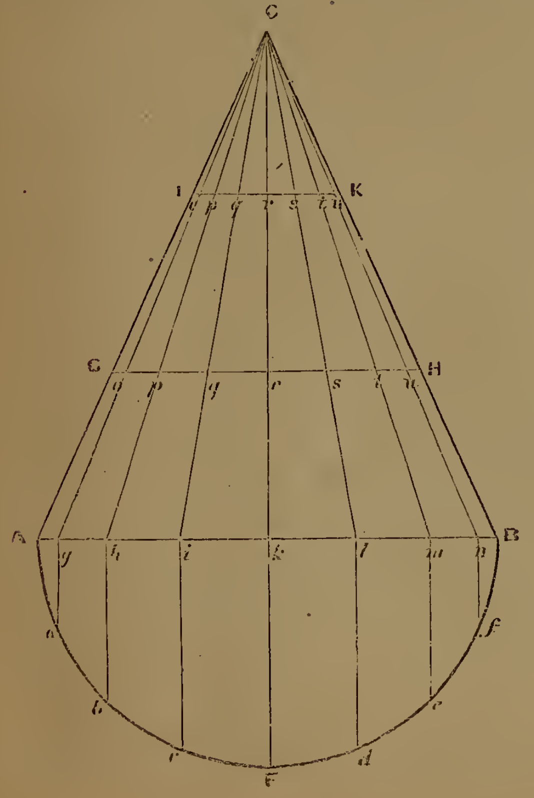
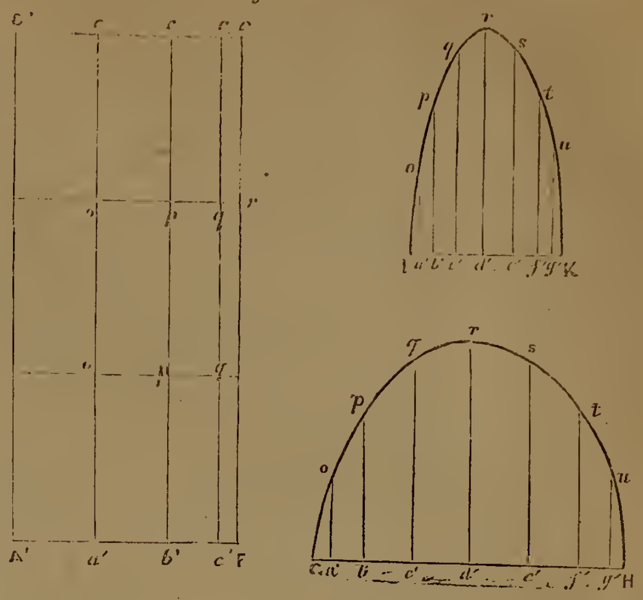


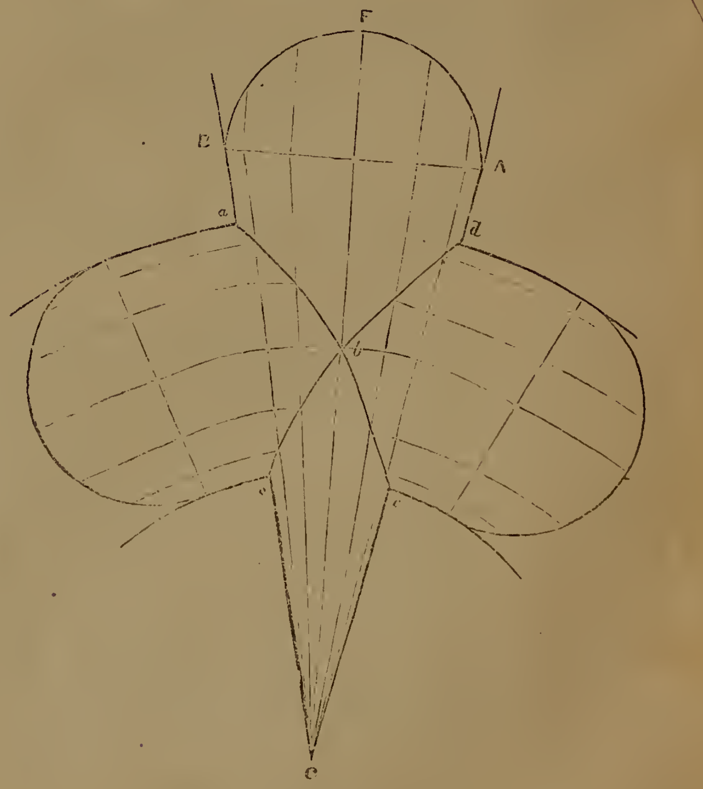
Fig 12 *continued.*



This form of solid is of great utility in the formation of the groins which are formed in circular aisles of churches, &c., and also in the arched heads of door and window openings, where the jambs are splayed, and the crown of the arch on both faces of the wall remains of the same height.

Fig. 13 represents a cylindric ring, intersected by a cuneus solid. The lines of their intersection are curves, as shewn by the lines a b and b c; but if the intersection of the surfaces of each solid is required to be in a straight line, as shewn by the lines $b d$, $b e$, the section of the ring will have to be accommodated to meet the heights upon the cuneus solid in the planes of their intersection.

Fig. 13.



OBLIQUE ARCHES.—NO. I.

Let A K C L, fig. 1, plate XXIX., represent the abutments of a cylindrical arch with spiral beds and joints. Let B C be the obliquity of the arch, and the circles E' A' B' F' the thickness of the ring which composes the arch :—Required the working moulds for the voussoirs and the quoin heads.

Lay down the development of the intrados and the extrados of the arch as shewn by the diagram fig. 4, of the coverings of solids. Let the curvilineal lines A C K L, fig. 2, represent the boundary lines of the development of the intrados, and N E M I the developement of the extrados, taken according to the thickness of the ring A' E' or B' F' in fig. 1. Draw the straight line A C in fig. 2 : from the point K let fall the line K *n* perpendicular to A C ; divide the line A *n* into the most convenient number of equal parts for the arch stones, and subdivide the line *n* C into the nearest number of equal parts which may approximate to the size of those on A *n*, Let *o n q r* and *s* represent the divisions on the line A *n*. From the points *o p q r* draw lines parallel to *n* K and cutting the line A K in the points 1. 2. 3. 4.; at right angles to A K draw the lines 1. 5., 2. 6., 3. 7., and 4. 8., let the line *t m* be produced, cutting the lines A K and L C when produced in the points *v* and *x*, draw also the lines *x y* and *v u* perpendicular to A K and L C; the line *x v* will be the development of the intradosial arris, and *y u* will be the extradosial arris of the coursing stones; draw the remainder of the extradosial arrises *e* 9., *f* 8., *g* 7., *h* 6., &c., parallel to the line *u y*; draw also the heading joints *b b b b*, &c. of the intrados; the position of the extradosial heading joints are drawn in lines from *a* to 10., 6. to 11., 7. to 12., &c., as shewn by *a a*, *a a*, *a a*, &c.

To Find the Bed Mould for the Coursing Joints.—Let A' H' B', in fig. 3, be the right section of the cylinder of the arch or the centre upon which the arch is turned; in fig. 2 take any point H in the central line of the development of the intrados, draw the perpendiculars H *b* and H *t*, cutting the line *v x* in the points *b* and *t*. In fig. 3, make the length of the arcs H' *b* and H' *t* respectively, equal to the lines H *t* and H *b* in fig. 2. In fig. 3, draw the perpendicular lines *b u* and *t v*. From the line H H, in fig. 2, draw the lines H *u* and H *v* perpendicular to H H, cutting the lines *b u* and *t v* in the points *u* and *v* draw the line H' *z*, make *z x* equal to H' *c* and through the points *u x v*, draw the circular line *u x v* which is the curvature for the coursing joints or beds; make *a' b* equal to the thickness of the ring stones; also make *b b* equal to the length of one of the coursing stones as shewn on the development of the intrados, draw the lines *a' b'* and *a' b'* to radiate towards the centre of the curve and the mould lines are obtained.

To Find the Mould for the Heading Joints.—Draw the perpendicular line P *w*, cutting the line *t v* in the point *w*. Draw the chord line *u w* : make the versed line S *t* equal to H *c*, and through the points *u t w* draw the circular line, which is the curvature of the heading joint; make the length of the circular line *b' b* equal to the line *b b* in the development of the intrados, draw the lines *a' b'* and *a' b'* to radiate towards the centre of the circle, and the mould is obtained.

The angle for the twist of the beds is shewn by the lines *x u* and *v y*, in fig. 2, from which the rules are drawn. By referring to the plate the mode here shewn is sufficiently clear without further explanation.

To Find the Bevels for the Quoin Heads.—Let *b b b*, &c., fig. 2, represent the first heading joint of the intrados from the face of the arch, and *a a a*, &c. the corresponding points of extrados of the same joints. Then in fig. 3, produce the line of curvature of both the arcs of the intrados and extrados from *a'* to G and *b'* to F, let *a b* in fig. 3, represent the heading joint; transfer the distances from *a o* in fig..2, to *a c* in fig. 3, and *b l* in fig. 2, to *b l* in fig. 3. Join *b l*, and the line *b l* forms the angle of the face with arris of the intrados. The remainder of the bevels for the quoin heads to be obtained in a similar manner; thus *d m* in fig. 3 will be the bevel for the joint head *d m* on the drawing fig. 4, and so on until the whole of the bevels are obtained.

Having obtained the moulds as above shown, the next thing to be done is to procure the material for the ring stones; the length of each stone may be obtained from the moulds for the coursing beds, taking care to make the requisite allowance for the twist of the heading joint; the extra thickness for the twist of the beds may be obtained from the rules O and P in fig. 2 for working the twist of the beds, by ascertaining how much the triangular shaped rule increases in its width in the length of one of the stones.

The block of stone for one of the stretchers being placed on the banker, begin by working the first draft of its upper bed; let this draft be the one intended for the intradosial arris of the stone, and let its width be sufficient to allow of the end moulds being applied fully in their position without having recourse to any alteration of the intradosial arris after the bed is worked, having thus far premised, assume a point at each end of this draft at such a distance from the rough edge of the stone as is requisite for that purpose; from each of these points set off the width of the bed and form a second draft on the same surface at the width thus specified. Let this second draft be cut in to such a depth so that by applying a parallel rule on the first draft, and the triangular shaped rule on the second, the two upper edges of the rules may be out of winding with each other: it must be observed, however, that whenever these rules are applied their distance from each other must be exactly equal to the width of the coursing beds, from which the drawings of the developments of the intrados and the extrados have been made. After the surface for the upper bed is carefully worked to the drafts already described; next apply the mould for the coursing joints (which ought to be made of zinc), mark off the boundary of its surface and square the ends of the stones from the surface of the bed, and with the mould for the heading joints complete the stone in the same manner as is usual in the common arch.

In working the quoin heads, the stones for each quoin must first be worked in a similar manner to the stretchers; and with the moulds for each of the beds as shown by fig. 3, whose lengths are carefully set off from the heading joints of each stone, the arrises for the faces of the quoins are determined. Fig. 4, shows the elevation of the arch, on which the letters of reference for the bevels of the quoin heads are marked; with respect, however, to the shape of the faces of the quoins in this elevation, they are of no practical use in the execution of the work. The mode of laying down the sections of the beds at their intersection with the face of the arch is by drawing the inner and outer elliptic curves, and transfering the exact distances of the joint lines upon each curve from the divisions of the curvilinear lines which form the boundaries of the developments of the inner and outer surfaces of the ring stones.

ART IX.—REMARKS ON CUTTINGS, EMBANKMENTS, AND OTHER EARTHWORKS.

On the Slopes of Cuttings, and the Means of preventing Slips.

In considering the case of the London Clay, in the last number of THE ARTIZAN, (see p. 210,) we recommended an expedient for carrying off all the water before it arrives at the face of the slope. This expedient is one which may be generally applied in all extensive clay cuttings where slips are apprehended from the irregular mixture of sand and clay, or from the frequent alternation of porous and impervious beds. We shall proceed to give some further explanation of this plan for carrying off the water by means of deep rubble trenches. In shallow cuttings, not exceeding 12 or 15 feet in depth, about two feet width of trench will be sufficient; and for deeper cuttings it may be advisable to adopt 3 feet, on account of the greater pressure which the rubble work will have to sustain, and the consequent tendency to choke up. No difficulty can be experienced in executing the trench in shallow cuttings, as the rubble stones can be thrown in as the excavation proceeds, and the whole be completed before any slipping or falling in of the sides takes place. In cuttings of great depth, however, the execution of the trenches will be attended with more difficulty, in consequence of the tendency of the sides to fall in before the excavation can be filled with the rubble stones. To guard against this, the filling in must follow the excavation as closely as may be found practicable, so as to leave the upright sides exposed for as short a distance as possible. In cutting these trenches, it will be advisable to employ a great force of men, who should proceed with the work in steps, that is, on a number of different levels, so that each gang shall work at a convenient face for falling; and as not more than one man with a pickaxe can work at each face in the trench, the depth of the face should not exceed about 4 feet. The recently-patented American Excavator, which is worked by a steam-engine, would be found well adapted for executing a work of this kind, but we are of opinion that a modification of the ladder-buckets and endless chain of the common dredging-engine, would answer the purpose still better. Where a large quantity of trench-cutting had to be executed, it would probably be found economical to construct a ladder with strong iron cutters and buckets, 3 feet wide, and to apply a steam-engine to give motion to the endless chain, and to the buckets fixed upon it. This application of the dredging-engine to the purpose of extensive excavation is not perfectly new, as it was introduced on the Caledonian Canal by Mr. William Hughes, whose engines were successfully employed in cutting the canal through the dry land, from one lock to another.

Before leaving the subject of these trenches, it may be well to observe, that where rubble stone suitable for the purpose cannot be procured at a reasonable expense, the water might be *cut off*, instead of being *carried off*, by filling the trench with a good clay puddle, and this latter will in most cases be found cheaper than the stones. Wherever any kind of hard rubble, in which every stone shall exceed 4 cubic inches in size, can be procured, the preference should be given to the plan for *carrying off* the water, first, because there is no danger of the rubble work failing to effect its purpose, and, second, because it takes the water off by degrees, as fast as it arrives, so that no accumulation is occasioned, no great pressure takes place against the rubble wall itself, and no saturation of the land above. The clay puddle cannot entirely be depended on for effecting all these purposes, while in fact it obviously occasions the latter evil, that of damming back a column or sheet of water, which is kept constantly pressing against the dam, and saturating the land above to such an extent, that it will probably injure it by finding an escape at the surface. The extensive plan of draining by means of a rubble dyke, constructed as proposed, within a trench at the back of each slope, will not only effectually protect the railway from the danger of slips, but will greatly improve almost any description of land on which it shall be found necessary. The strong stiff clays and marls, which require expensive systems of drainage, are precisely those which commonly cover the tracts where so much trouble and expense have been caused by the slipping of slopes; and hence these cannot fail to benefit in a high degree by the complete and most effectual drainage to which the rubble trenches will lead.

Plastic Clay Formation.

This is the lowest term of the tertiary series, and is applied in this country to the clays and sands which rest immediately upon the chalk, being interposed between the latter and the blue clay of London. The plastic clay consists of alternate strata of sand and clay, without limestone or nodules of septaria, these being confined to the superior London clay, which is distinguished by the presence of these minerals. The plastic clay is exposed at the surface of the ground, by denudation of the superior deposit, throughout a great part of Essex, Herts, and Bucks, in which counties it occupies a belt varying from 5 to 10 miles in breadth, and extending from Sudbury to the river Thames at Maidenhead. The plastic formation is then covered by the London clay as far as Reading, where it again appears, overlying the chalk in the vallies of Berks and Wilts, extending into the latter county nearly as far as Marlborough. Again skirting the London clay by Odiham, Guildford, Leatherhead, and Epsom, the plastic clay along this line does not average more than a mile in breadth. At Croydon, however, it becomes wider, and continues through Kent to occupy the whole space between the chalk and the marshes of the river Thames. The plastic clay formation of the Isle of Wight basin is also of considerable extent in the counties of Sussex, Hants, and Dorset. Commencing at Shoreham in Sussex, and extending by Chichester, Portsmouth, Romsey, and Salisbury, in a belt averaging about 7 miles in width, it terminates at Dorchester, which is about 93 miles east of its commencement at Shoreham. The Kennet and Avon Canal has the greater part of its course in this formation, which is also intersected by the Grand Junction and Basingstoke Canals, and by the Lea Navigation. All the principal railways from the metropolis, except the Eastern Counties, traverse the plastic clay of the London basin, and two of them in particular, the Great Western and the London and Croydon, have cuttings of great magnitude through the plastic clay. The Sunning Hill cutting on the Great Western Railway, which will be remembered by our readers as the scene of a very fatal slip two years ago, consists of the plastic clay; and the great cuttings of the Croydon Railway, from New Cross up to the summit on Forest Hill, consist wholly of plastic clay, except that the tops of some of the hills are capped for a few feet in depth by the blue clay, containing cement stones. We have not at this moment the particulars of any analysis of the plastic clay, which can be depended on; but it appears to contain more silex and less alumina than the blue clay; and probably to this circumstance, and to the more frequent occurrence of beds, veins, and partings of sand, is owing the highly dangerous character of this clay. We have before adverted to the fact of the London clay having been often improperly judged of, in consequence of mistakes as to its identity, and we are decidedly of opinion that the plastic clay is a much more dangerous material, and one which, generally speaking, requires more extensive measures in the way of drainage for its protection, than any other which can be pointed out.

It has been commonly observed, as the result of experience, that no distance of time, and no appearance of stability, afford any security against the slipping of this very dangerous clay. It has been found that slopes which have been executed two, three, and four years ago, and which, during this term, have presented no indications of danger, have all at once assumed an unsettled condition; and the first slip, whether large or small, has commonly been followed by numerous others in rapid succession.

The great cutting through the plastic clay on the London and Croydon Railway, affords, perhaps, the best example which can be found of the nature of this material. This cutting commences at New Cross, where the old Dover road passes over the railway, and extends for about two miles and a half towards Croydon. The first three-quarters of a mile consists of very heavy work, the depth of cutting being in one place 84 feet, and it was in this deep part that the first slips took place, about two years ago, and to which they were confined for some time. At first the company's operations were directed, at a very heavy expense, to the removal of the slips which took place near New Cross Bridge, these being so extensive as to impede, for several successive weeks, the passage of trains upon that part of the railway, and rendering it necessary for the passengers to alight and scramble over the heaps of fallen *debris* which choked up the cutting, until they reached another train, which was in waiting on the other side. All may readily conceive the effect of such a state of things upon the financial prosperity not only of the Croydon Railway itself, but of the other two great lines which branch off from it into the south and south-east of England. It was stated in January, 1842, that 1,500 men were at that time employed in removing the slip in the deep cutting, at an expense to the company of £300 a-day. Not only has an enormous mass of unbroken ground come down into this cutting, but it has also most unfortunately happened that heavy spoil banks had been reared so close to the margin of the slopes, that a great deal of this stuff has also to be removed, and the expense of repairing the mischief has thus been most vexatiously increased. Nor is this all: the giving way of the slopes was not long confined to the deepest part of the cutting, but has gradually extended throughout the whole length of two miles and a half; and all through this large proportion of a line whose whole length is under 9 miles, the slopes present the most lamentable appearance. In order to give some idea of the measures which are being taken to stop the frightful progress of this incessant slipping, and of the immense expense to which the company has been subjected in consequence, we shall refer to a Report made by General Pasley, in September, 1842, in which he recommends the Board of Trade to empower the company to take possession of additional land, for flattening their slopes and depositing their spoil banks.

General Pasley observes, that the soil in this deep cutting has proved so very treacherous, that an immense quantity of earth still requires to be removed from both sides of the cutting. The additional land required by the company is no less than 51½ acres, which large amount the General considers "absolutely necessary to enable them to put their cuttings in a safe and efficient state; and unless they obtain what they request, not only will the railway be liable to dangerous obstructions by slips, but the ground on each side, including part of the present spoil banks, will come down by the action of nature. Of this a remarkable instance has occurred at Forest Hill."

In the month of July preceding this Report, General Pasley had inspected the ground with Mr. Gregory, the engineer of the railway, who was of opinion that it would be necessary to alter the slope of the cutting on one side of the railway to 3 to 1, and besides to give it a margin, or bench, of 30 or 40 feet. After carefully examining the ground, and the state of the slip which had already occurred there, and which threatened to spread still further, General Pasley so far differed from Mr. Gregory as to think at that time that a base of 4 to 1, with the margin proposed by Mr. Gregory, would not be more than enough to ensure the stability of the cutting. In his present Report, General Pasley states that the ground now required by the company had been set out according to his suggestion in July, but so many successive slips had taken place since that time, that the company will be obliged to demand still more land, unless they can take possession without delay, as every day's rain produces a very unfavourable effect.

By this Report of the Inspector-general of Railways, we are put in possession of the proceedings adopted by the company for putting this great cutting through Forest Hill into a sound state. The slopes are being cut back at the rate of 1 foot perpendicular to 4 feet base; and about half way up the slope a horizontal bench, or margin, of 30 or 40 feet in width, is formed.

The following brief statement will show the enormous expense at which the company are executing this work, as compared with the expense of putting the slopes in a far more secure state by means of the drainage already described.

Cost of excavating the Slopes of a Cutting 30 *feet deep, at the rate of* 4 *to* 1, *with a Bench in the middle of* 30 *feet.*

500 cubic yards of cutting, at 1s.	£25	0	0
100 square yards of land, at 1s.	5	0	0
Cost per yard lineal, as executed . . .	£30	0	0

Cost of excavating the Slopes of a Cutting 30 *feet deep, at the rate of* 1½ *to* 1, *with a Rubble Trench at the back of each Slope, for the purpose of complete Drainage.*

150 cubic yards of excavation in the slopes, at 1s.	£7	10	0
20 cubic yards of cutting in the trenches, at 2s. .	2	0	0
20 cubic yards of rubble stone, at 5s.	5	0	0
40 square yards of land, at 1s.	2	0	0
Cost per yard lineal	£16	10	0

This plan of effectually securing their slopes, in a far more complete manner than they will do according to their present method, would thus save the company about £13 10s. per yard lineal; or, on a moderate calculation of two miles in length of cutting, the saving would be £47,520. These facts will be found worth the attention of the shareholders and their directors.

Cuttings in the Gault Clay.

This is a member of the green sand formation, which everywhere passes under the chalk, being separated by this latter from the plastic clay which has just been described. The several divisions of the green sand may be traced in all parts of England where the formation exists, and they are always found occupying the same relative position with respect to each other, and to the main formations between which the aggregate mass of the green sand is interposed. The gault clay is not in immediate contact with the chalk, but is separated from it by a very peculiar rock, called firestone, from its property of resisting intense heat. This firestone, which is the upper term of the green sand formation, is an arenaceous rock, in which the grains of sand are intermixed with numerous minute scales or plates of mica, and with occasional grains of the green silicate of iron. The firestone is commonly about 30 feet in thickness, and between this rock and the reddish-coloured iron sands of the same formation, the gault clay is interposed.

It will be unnecessary to describe particularly the range and extent of the gault clay, because it everywhere surrounds the well known and well marked escarpment of the chalk formation, and may readily be traced, not only on a geological map, but on any ordinary map of England in which the shading is sufficiently distinct to show the elevated range of the chalk hills, which form so prominent a feature in the eastern and south-eastern parts of this island.

The breadth of country occupied by the gault varies with its dip, or inclination. Where its beds are most highly inclined, it occupies the least breadth of surface; and where the beds have only a very trifling inclination, its breadth at the surface is obviously the greatest. Thus, where the gault passes under the chalk range of the North Downs, in which the beds of the gault, in common with all its associated rocks, are inclined at a considerable angle, the breadth occupied by the gault is very small, probably not more on the average than about 300 yards. The same thing is the case with the gault which underlies the South Downs, in Sussex and Hants, where its breadth is also quite inconsiderable. The gault, however, is found in widely different circumstances, where it surrounds the chalk in Lincolnshire, Cambridge, Bucks, Beds, &c. The chalk itself occupies, in this part of the country, a much greater extent of surface, in consequence of the more nearly horizontal dip of its beds; and the same remark applies to the gault, and the other members of the green sand, which succeed the chalk in descending order.

This clay performs functions of great importance in the economy of nature. Where it exists in connection with the highly-inclined strata of the North and South Downs, it serves as an overflowing dam, to keep up the water in the chalk to a fixed level, at which it flows over the dam formed by the gault, and gushes forth from innumerable springs, feeding as many minute streams, which ramify in every direction over the barren surface of the lower green sand. These streams, if properly directed, might be converted into a source of almost boundless fertility. As it is they carry with them a great quantity of argillaceous matter, which they deposit in the elbows and angles of their winding course. It is a striking comment on the backward condition which agriculture exhibits, to reflect that this very disposition which Providence intended for the benefit of the country, for the exercise of ingenuity, and the employment of useful industry, should be absolutely lost sight of and disregarded; if, indeed, it be not perverted by the blind ignorance and obstinacy with which agriculturists oppose the interference of science with the cultivation of the soil. In place of that high state of fertility which every one knows would result from the mixture of soils so corrective of each other as an arid sand and a retentive clay, and which might be developed by a judicious and comparatively inexpensive system of warping and irrigation, what is it that we find in reality throughout the plains of the lower green sand?

We find the course of its streams, capable, as they are, of diffusing life and fertility throughout the neighbouring tracts of barrenness, marked by the rank, coarse, herbage of the semi-morass, and all along on either side we trace the gradual formation of the bog, proceeding as uninterruptedly as if the earth had no inhabitants, or at least as if industry were unknown, and the duties forgotten for which men were allowed to people the earth. The time will come when a more rational system of agriculture shall dictate the employment of these streams for fertilizing the land. We shall see them carried to the highest levels at which they will flow, periodically depositing the valuable earths and salts which they contain upon the very soils where these are most wanted. They will then be diverted from those tracts in which they have already done great mischief, by forming and adding to a puffed-up, spongy soil, made up of rank vegetation, intermixed with clay enough to preserve it from decomposition, and destined in ages to come for a perfect bog, as complete in all its characters as if it had been formed before the world was modelled to receive its present race of inhabitants.

Where the gault clay again occupies a considerable breadth of country, where its beds are not so highly inclined, and where it rises to nearly as great an elevation as the chalk which it surrounds, it serves the office of throwing back numerous important rivers in the green sand, and in part of the chalk district. These rivers, after diffusing great agricultural benefits and great commercial advantages, by the powers which they afford for working mills, fall into the Thames at various parts of its course. The rivers here spoken of are the Lea, the Ver, the Gade, the Colne, and some others.

The gault clay is commonly of a blueish colour, of various shades, ranging from a bright to a dull blue. Its structure is close, dense, and compact, and its capacity for retaining water very great. Being a plastic clay, fit for the purposes of pottery when mixed with proper proportions of sand, the gault possesses this latter property of retaining water in pools and hollows on its surface in common with all the other plastic clays. The gault is commonly without vertical fissures or joints, at least without any which are apparent, but is divided into beds or strata by very thin partings of sand, less than one-eighth of an inch in thickness.

In the fen country of Lincolnshire and Cambridge, the subsoil below the diluvium, which occupies the first few feet in depth, is provincially termed gault clay, although in reality it belongs to the oolitic series.

In connection with the general subject of earthwork, may be mentioned the great amount of excavation carried on in the gault of the fens by the agriculturists in that part of the country, for the purpose of improving the quality of the light peat which rests upon it. The farmers there dig trenches about three feet wide down to the gault, into which they excavate two or three feet deep, and throw up the clay to the side of the trench, which is then partly filled with the peat, and the gault left on the top to be ploughed in with the light earth, which is greatly improved by the mixture. This process, which is called gaulting, is said to have been introduced by the celebrated Sir Joseph Banks, and the results which have attended the use of it, and the prosperity which has been created by the system, confer additional lustre upon the memory of that accomplished individual.

Where the gault is developed around the chalk of Hertfordshire, Bucks, and Oxfordshire, it rises into eminences of sufficient height to influence the levels of the canals and railways which intersect it. Considerable cuttings through the gault may be seen on the London and Holyhead road at Crown Hill and Forty Mile Hill, between Hockliffe and Fenny Stratford. On the Grand Junction Canal, beyond Tring, in Bucks, and on the London and Birmingham Railway, there is a deep cutting, with a tunnel through the gault, between Leighton Buzzard and Linslade. The slopes adopted by Mr. Telford, for his cuttings through gault on the Holyhead road were 2 to 1 on the north side, and 3 to 1 on the south—a difference which he may have considered necessary in consequence of the heavier rains and severer frosts to which the southern slope is exposed. The gault clay, both on the Holyhead road and the Birmingham Railway, is dry and firm, containing only a very minute quantity of sand in its partings. It contains numerous nodules of chalk interspersed through it so irregularly as to authorise the supposition that the upper part of the gault has been disturbed by water since its deposition. This disturbance probably took place at the time when the chalk was so extensively denuded, as it is universally admitted to have been, by the overflow of waters, confined within ancient barriers, which have long since been swept away. It is evident that torrents of water rushing over the chalk, carrying with them fragments of the latter, and ploughing up furrows in the yielding soil of the gault district, would be likely to scatter and deposit such small fragments as we now find mixed up with the gault.

With reference to the slopes which may be adopted in this kind of clay, it will not be necessary to say much, as it does not possess the dangerous character peculiar to the London clay. It is remarkable that so few brick and tile kilns are to be found thoughout the great extent occupied by the gault in this country. The objection we have heard is that the gault is too strong for a brick earth, and this may possibly be the case if employed without mixture with sand. Abundant quantities of sand are always associated with the gault in those parts of the green sand formation between which it is interposed as already described. The fact that the gault is admirably adapted for the purposes of pottery is borne out by the manufactures of France, in which country not only all the most celebrated bricks and tiles, but some of the more valuable articles in pottery, are fabricated from the clay of the gault. Long before the geological place of the gault clay was known, and before the gault of France was identified with the same clay in England, we find the band of clay which bordered the great chalk escarpment in the former country described as the seat of many celebrated potteries, brick-fields, and tile-works, established in the localities which they severally occupy, because the clay (now ascertained to be identical with the gault clay of England) was of a quality highly superior, and of so high a degree of purity as to burn almost to a white colour.

Art. X.—OUR CLUB. No. VIII.

> "Now stir the fire, and close the shutters fast,
> Let fall the curtains, wheel the sofa round,
> And while the bubbling and loud hissing urn
> Throws up a steamy column, and the cups,
> That cheer but not inebriate, wait on each,
> So let us welcome peaceful evening in."—Cowper.

Scene.—*Club Room.*

[*On the chimney-piece the magic reporter, shaped somewhat after the fashion of a magic lanthorn.*]

Present Sir Jonah, Montgomery, and Scalpel.

Sir Jonah *(laying a newspaper on the table)*. So then Pattison, the free-traders' choice, is returned as a "fit and proper person" to represent the City of London in Parliament. This is, indeed, a "heavy blow and great discouragement" to monopoly.

Scalpel. Great, doubtless, will be the rejoicings of free-traders, generally, and of the Anti-Corn-law League especially, whose exertions have been so instrumental to Pattison's success.

Montgomery. This blow will tell with a tenfold weight, in consequence of having been struck in the stronghold, in the very citidel, as it were, of monopolies of all kinds, from the huge, overgrown East and West India interests, down to the pettiest monopolies of porterage and cartage. Here were these manifold and multiform interests (though so diverse, yet still bearing on their features the stain of their common origin), here were they banded together in all the plentitude of power; nevertheless, they were constrained to succumb to the free-trade principle.

Sir Jonah. Any manifestation in this seat of commerce and of empire, whether for good or for evil, must needs be felt through every part of the body politic, even as health or disease is transmitted by the action of the heart to the extremities of the human frame.

Scalpel. I have long withdrawn myself from the strife of mere party politics, in which, in my hot youth, I took a fierce delight. Oh! that stormy sea of politics! how many a noble heart has it not wrecked!—how many a gallant spirit, tempest tost, have not its greedy waves devoured! Is it any wonder that so little good to the community results from the ungainly efforts, from all the hubbub of political strife, when we consider how rashly and unprepared the bulk of men embark on its tempestuous waters?—Without ballast, without chart or compass, or even rudder, is it any wonder that we are borne hither and thither at the mercy of the winds and waves; and that all our exertions end in a world of unprofitable toil—ending just where we began? And what are Tory, Whig and Radical, but terms made use of by designing knaves to further their own selfish aggrandizement? Loud is the cry of those political charlatans about the glory of our constitution, or its abuses; and whilst we listen with stupid wonderment, like clowns at a country fair, lo! our pockets are picked, and we have only our own folly to thank for the result.

Sir Jonah. Nay, Scalpel, you are in one of your bitter humours this evening. Your remarks, though true enough in the main, are too general; and, as respects the late hand-to-hand contest in the City, surely the distinction between the two candidates was something more than a mere name. A mighty principle was at stake, the recognition of which, by the majority of the electors, redounds highly to their credit. In free trade are bound up some of the best interests of man.

Montgomery. In turning over the leaves of this volume of Dr. Chalmers' I have accidentally alighted upon the following Johnsonian passage, which the Anti-Corn-law League might take for a motto:—"The philosophy of free trade is grounded on the principle that society is most enriched and best served when commerce is left to its own spontaneous evolutions, and is neither fostered by the artificial encouragements, nor fettered by the artificial restraints of human policy."

Sir Jonah. That the terms Whig, Tory, and Radical, are often used without any very definite meaning, and that other words might with advantage be substituted for them, cannot but be granted. Indeed, such a change has already taken place in the substitution of the words Conservative and Liberal, to indicate the two great divisions of the political world, and which change of words may be looked upon as an outward and visible sign of the inward change, indicative of a more gentlemanly tone being breathed into modern politics, and of a softening down of its asperities.

Montgomery. The *stand-still* and the *go-on* would, perhaps, better indicate the respective policies of the two parties.

Sir Jonah. They would. But while by Conservative we know is meant one who would fain uphold the present state of things as long as he can, and by Liberal one who seeks, more or less, to alter and accommodate them to the passing exigencies of the time, they will serve well enough, especially as they do not smack, as did the terms they have well nigh superseded, of any vulgar tauntings in their origin, Whig being, as you of course know, derived from whiggamoor, a species of Scotch marauder, and Tory having a kindred derivation from an Irish robber.

Scalpel. I am sure, Sir Jonah, you would be the last person to palliate that abominable party spirit so rife in this country. It fills one with disgust, especially when found in connection with Liberalism. Far more distasteful than the narrow-mindedness of Toryism, or its more modish sister Conservatism, is the illiberality of pseudo-liberals. It comes from the latter with so ill a grace, sits so awkwardly upon them, and is so much at variance with their professed principles, that the cloven foot is instantly detected. Those who are so liberal *in* and *to* their *own* views, should surely extend the same privilege to others.

Sir Jonah. There spoke my honest-hearted, clear-sighted old friend himself. Mistake me not, Scalpel. I look on government but as a means of furthering the real good of a nation; that which will do this the *best* and *cheapest* (for even the protection of a government may be bought too dearly!) obtains my suffrage. As the people become more enlightened, they will cease to be nose-led by any class of political adventurers, however nicknamed, whether Tory, Whig, or Radical. The fudge, and gibberish, and cant of party politics are losing their effects as men awake to a consciousness of their real interests.

Scalpel. Public opinion is becoming every day more respected and feared.

Montgomery. Yes, *feared because respected;* for public opinion is in itself, abstractedly considered, neither good nor bad. It may be either. It is so far good when conjoined with public enlightenment; deprived of this it is nothing worth. In bygone times, public opinion—such was its madness—was yelled forth against poor old men and women ycleped wizards and witches; and, even later, was it not in direct opposition to the Catholic claims?—and did it not burn with a fierce wrath against Priestley, Wesley, and others, who, despite their dissimilarity, were all true friends to their species? But a change is come over the times. The spirit of inquiry is afloat. The prejudices of ages are breaking up. Truth, with her Ithuriel spear, puts to flight the phantoms engendered by the long-continued nightmare of ignorance; in her mirror we behold ourselves with different aspects, as we *were*, and *are*, and as we *should be*. With the increase of knowledge, public opinion is, indeed, becoming a thing to be respected and feared. Already do monarchs stand in awe of its power. Abuses of all kinds are fast fading away before its increasing might, and ultimately it will produce a mighty moral revolution.

Scalpel. Those who censure the working classes for their occasional outbreaks, forget that their depravation proceeds in a great degree from misgovernment, and that their rulers are, therefore, so far responsible for their degraded state. Let not those, then, who, by their wanton expenditure of public money, and by unnecessary wars, have ground the people to earth with excessive taxation, and have sedulously kept from them the fruit of the tree of knowledge, lest they should "eat and be wise;" let them not dare to ridicule and insult the victims of their cupidity, nor wonder that the very guilt and wretchedness they have themselves engendered should sometimes burst forth to crush the guilty, foul oppressor with a terrible retribution. It is just that it should be so, to teach tyrants a lesson—to show kings and princes that their thrones are secure only when based on the affections of their people.

Sir Jonah. They err egregiously who think a diffusion of knowledge inimical to the well-being of any state. Where are revolutions most prevalent but in kingdoms immersed in barbarism, or just emerging from thence? Look at Russia. How often did the bow-string, and the dagger, and the drugged bowl transfer the royal diadem from the brow of one tyrant to that of another?—and where did ignorance ever rest with more disgusting and brutalising influence than there, overshadowing the human faculties, and eclipsing the light of reason with its worse than Egyptian gloom? Look at the history of our own, and of every nation, from the infancy of its power to the maturity of its might, and see whether government was not more vacillating in times of ignorance, and stable in proportion to the public enlightenment.

Montgomery. That is natural. A government based on the clearly defined interests of the many must needs be more secure than that which trusts for support on only a few; just as the pyramid which rests firmly on its basis, would speedily totter and fall if placed on its apex.

Scalpel. He must be, indeed, blind to the signs of the times who sees not that a powerful change is working in the minds of mankind. Bright glimpses of the dignity and glory of human nature are beginning to unfold themselves, and gleam with gladdening influence athwart the gloom of our moral night.

Montgomery. You agree, then, with me, or rather with the poet:

> Though black with guilt's pollution, still our world
> Hath streaks of gladdening augury, that tell
> Of coming day, when Justice, Truth, and Love
> Shall dwell with men; when childlike Innocence
> Shall nestle safely with the serpent Cunning;
> When Right shall be in strictest league with Might;
> When Sorrow's tears—what few may then be shed—
> By watchful Sympathy shall soon be staunched:
> Love the sole law which then shall govern all.

Sir Jonah. I question much whether even you, with your poetical temperament, any more than Scalpel or myself, anticipate any very speedy coming of the moral millenium which your lines (for I take you and the poet to be one) have so vividly described. Still there are grounds for gratulation and hope, even in the present aspect of affairs, to all who love their fellow-men, and who sigh after the most distant approximation to your heaven upon earth. Men begin to recognise—though still vaguely—their real interest. The working classes have awoke to a consciousness of their power, and in what it consists,—that individually they are nothing, but in the aggregate everything. Union is now the order of the day. And though they have used their newly-discovered power as yet imperfectly and irrationally, yet they will soon learn to husband their strength, and to direct it aright. They feel that the true question is not whether their condition be better or worse than it was at any former period, but *whether they are paid commensurately with their real worth as the producers of all wealth.* Let them persevere in their bond of union. One good, at least, will ultimately result from their conjoint efforts—the poor man's labour will be duly represented, along with the wealth of the capitalists and of the landed proprietor.

. . . .

Sir Jonah *(adjusting the box on the table).* There, I believe it is all right again now. I am sorry to tell you, gentlemen, that, for the last half hour or so, we have been "wasting our *wisdom* on the desert air." My magical reporter (plague on't! I can't get a Greek compound to please me)—my magical or self-reporter, which I tested, as you will remember, at our last meeting, has somehow got out of order; so that your caustic sarcasms, Scalpel, and your bursts of enthusiasm, Montgomery—to say nothing of my own profound disquisitions—will be all lost to the world.

Scalpel.—Your instrument, or machine, then, is not perfect as yet, Sir Jonah, even in its simplest form—that of being a mere word-reporter? Do you think you will ever achieve that wonder of wonders of which you spoke at our last Club meeting, namely, *sound*-printing, whereby the world will be able to read the tones of the speaker's voice, as well as his bare words?

Montgomery.—Ah! that would be an invention worthy indeed of our President. Do you still think it feasible, Sir Jonah?

Sir Jonah. Why not? Do you not read sounds at present in musical notation? Believe me, the thing is not only possible, but is much nearer its completion than you can possibly conceive. You shall see! You shall see! All in good time! As for the slight hiatus in our colloquy caused by the imperfect working of my self-reporter, and which the world may excuse more readily than you seem to do, it is surely sufficient for me to allude to the newness of the invention, and to direct your attention to the excellent report which it gave of our last month's Club. Could any man-reporter, any mortal transcriber, give more faithfully the subject-matter and the very words of our discourse, than did this inanimate box? Could it have been more correctly rendered, if the compositors had stood at our elbow, and snatched the words from each one's mouth as they were uttered, and transmitted them into type? Answer me.

Montgomery. I cannot dispute—nay, I admire—the rigid accuracy of the report.

Scalpel. Of its literality there can be no question; it is a fac-simile—I would almost say, it is more real than the reality which it purposes to *type*ify.

Sir Jonah. Then, as regards the slight imperfection in its night's working, I would ask, Did you never know of a man-reporter (the phrase, though it may sound queer, is now necessary)—did you never, I ask, know of a man-reporter falling asleep over his notes, or dropping down in an apoplectic fit; or, after having made his notes, being unable to decipher them? Did you never hear of these and a hundred other accidents to which the man-reporter is liable? Did you never hear of speeches being burked by agreement of short-hand writers? Fancy, I bid you only fancy, my self-reporter, on an extended scale, with all its collateral improvements, placed on the table of the House of Commons, near to Mr. Speaker's mace, or in the House of Lords, close to my Lord Chancellor's elbow—where then, think you, would be the need for that band of misinterpreting scribes the reporters? There is this other advantage attending my magical reporter; if by any mischance, as that of to-night, it fail in common with reporters to give what is said, it will never, as these men-reporters frequently do, put words into persons' mouths which they never uttered.

Scalpel. I beg pardon for the remark; but had you not better take another look into your box, Sir Jonah, lest it should fail even to give your glowing eulogium in its praise?

Sir Jonah (*Looks into the box*). It is still at work; but I see that one part of the apparatus has well nigh expended its power, and that the whole will require a re-adjustment. So we must be brief. That extract of yours, Montgomery, from "A Heart's History," which I purposed that you should give us (you being willing) before we broke up, you will please to send to the printer, that we may close gracefully; even as Cæsar folded his mantle over . . . . when . . . . stabbed.

. . . .

[The typographer's demon presents his compliments to the public, and begs to inform them that the rest of the manuscript is illegible—that the Club is gone out of town, and that he is Their obedient Servant.

Art. XI.—WEALE'S PAPERS ON ARCHITECTURE AND ENGINEERING.

1. *Quarterly Papers on Architecture.* Part I. London: Weale, 1843. 4to.
2. *Quarterly Papers on Engineering.* Part I. London: Weale, 1843. 4to.

We have here the germ of an undertaking which, if skilfully carried out, cannot fail to raise the literature of the arts into a higher position, and furnish engineers and architects with that practical information relative to their several pursuits, of which there is even yet so deplorable a penury. It is not to be expected that our pages, or pages such as ours, should yield in any great abundance that species of esoteric knowledge which alone is prized by proficients. Such wares are of too tedious a production for the exigencies of our market; and even were we enabled to dispense them with the hand of a prodigal, we should still be obliged to introduce them with moderation, as they would fail to satisfy the taste of our customers unless debased by less precious intermixtures. The dulness and inattention of many of the readers of such works as ours it is almost impossible to overrate; and if we were to restrict ourselves to those higher keys demanded by the more fastidious, we should cut ourselves off from that far larger auditory who have neither the courage nor curiosity for abstruse speculations. It is not, therefore, in our pages, or in the pages, we suppose, of any monthly periodical, that such information is to be looked for as will satisfy *skilful* engineers or architects; for the circle of the skilful is necessarily a narrow one, and works such as ours must address the many and not the few. In a quarterly work, however, the price of which is high enough to enable it to be content with a narrow circle of readers, a higher note may be safely sounded, and is indeed rendered necessary by the altered circumstances of the case; for those who have money and aspiration enough to purchase such a work, may be fairly presumed to have reached such a proficiency as will make them dissatisfied with any quality but the best.

For these and other reasons we might mention, we think that the circumstance of a crowd of monthly periodicals pretending to treat of engineering and architecture being already in the field, by no means supersedes the necessity of a quarterly work on the same subjects, which, by taking a higher ground, will necessarily address a different auditory. Such a work, indeed, has long been wanted, and we see no reason whatever why this want may not be supplied by the papers before us; for though they do not yet come up to our ideas of what such a work should be, we have no doubt of any defects in this being carefully eliminated in future numbers. Those, indeed, who have the least experience in periodical literature well know that a first number has a prescriptive claim to indulgence; the newness of the undertaking is of itself apology sufficient for many imperfections, and a high degree of excellence is often interdicted by the very solicitude to excel.

The engineering part of these papers opens with a life of Brindley, the celebrated canal engineer. This biography is well written, and manifests a familiar acquaintance with the pursuits to which Brindley was addicted; yet we question whether a subject of more practical moment would not have been more acceptable to the technical reader, by whom, it is plain, a work of this kind must be supported. The same remark applies to the life of Chapman which follows, and to the historical disquisition on the invention of the steam-impelled dredging machine—a point of about as much moment as the invention of the steam-impelled grindstone, for both applications involve about the same amount of ingenuity. The account of the engines of the Kamschatka, furnished by Messrs. Schuyler, of New York, is a modest and well-written paper; but we think Messrs. Schuyler are in error when they say that a long cylinder is necessary to the beneficial application of the expansive principle, the fact being that expansion is quite as efficacious in a short cylinder as in a long one. The arrangement of the Kamschatka's engines is shown in plate 30.

The next paper is entitled "Hints on some Improvements of the Steam Engine, by Joseph Gill," and is one of the most empty and puerile productions that has come across our path for many a day. We should be glad to know who the *engineers* are who are likely to derive benefit from such frivolities as the following:—

> "The power of a steam-engine, as deduced from theory, is in direct proportion to the transmission of heat from the boiler. The medium of transmission is steam, and as the steam must flow from the boiler to the cylinder through contracted tubes, and tortuous passages, it often undergoes a considerable change of temperature and density in its transit, besides subsequent modifications in the cylinder. In air, and permanent gases, the bulk is inversely as the pressure. When steam is subjected to pressure, a uniform temperature being preserved, its elasticity is partially overcome, a portion of it is condensed into water, and the remainder will occupy a space proportionately smaller as compared with a permanent gas under similar circumstances.
>
> "When a vessel containing steam generated under a given pressure is exposed to any cooling influence, the caloric which maintains the elasticity of the steam will escape with a velocity depending on its temperature and the quality of the surrounding medium; and under a constant pressure, any decrease of temperature must cause a partial condensation of the steam, and a corresponding diminution of its volume.
>
> "The particles of a homogeneous gas confined in a tube of uniform diameter, will generally retain their relative positions even during regular motion, or gradual contraction or expansion of volume, providing they are free from disturbing eddies or currents. We may assume that such is also the case with steam when no condensation accompanies the change of volume.
>
> "If a horizontal tube communicating with a steam-boiler at one end, the opposite extremity being closed, be filled with steam from the boiler, the loss of heat from radiation and the contact of the air, must cause a certain degree of condensation of the steam; and this condensation will be nearly uniform throughout the entire length of the tube. If an aperture is made in the closed end of the tube, so as to allow an escape of steam, a certain degree of motion will take place in the steam enclosed in the tube, and the quantity of condensation will become different at different parts of its length. If, as assumed above, each particle of steam retains its relative position in its transit through the tube, the condensation must be greater as the distance from the boiler increases. Consequently, the temperature of the steam gradually decreases from the source of supply to the farther extremity of the tube; but the pressure in the boiler being constant, the elasticity of the steam will be uniform, or nearly so, throughout the whole extent of the tube.
>
> "From the foregoing remarks we may deduce the following conclusions:—
>
> "1. That when steam at a constant temperature is subjected to a pressure greater than that under which it was formed, a certain portion is condensed into water, and the remainder assumes a bulk and elasticity proportionate to the pressure.
>
> "2. That when steam under a constant pressure undergoes a decrease of temperature, a corresponding condensation and diminution of volume take place.
>
> "3. That steam in motion through a tube exposed to a uniform cooling medium, undergoes a progressive decrease of temperature as the distance traversed by it increases, and, consequently, that the temperature varies at different parts of the tube.
>
> "4. That the pressure being constant, the elasticity of the steam is nearly uniform throughout the tube, notwithstanding the variation of temperature."

We take leave to hint to Mr. Gill that his future improvements should begin with himself.

We turn with much pleasure from the engineering to the architectural papers, the first of which is a very able essay, by Mr. G. Moore, on "the Powers of the Mind concerned in Design." The next is a useful practical paper descriptive of the Deptford Poor-house. After that we have a life of a Mr. Vitruvius Morrison—next, specimens of stained glass from York—and, lastly, a very interesting account of the Primitive Churches of Norway. The first paper is the only one we can now afford to say anything respecting.

Mr. Moore's purpose is to ascertain if there are any fixed principles in architectural design at all; and, if so, to determine what they are. The plan he has adopted in the accomplishment of this purpose is a good one, but is better suited, perhaps, to a plethoric essay than to the narrow limits to which we are restricted. Without pretending, therefore, to follow Mr. Moore very closely, we shall here set down a few miscellaneous remarks in illustration of the subject which even yet, we fear, are not altogether superfluous.

It is now scarcely doubted by any one who has given the least attention to philosophical inquiries, that the emotion of beauty is due chiefly, if not altogether, to association, and is the reflexion, so to speak, of certain primary affections of our nature. If this be so, the reflexion of those affections must, in every case, constitute beauty to the person concerned, whatever appearance it may wear in the eyes of another; and there cannot be such a thing as an absolute beauty, so long as the same object may be significant to different minds of different emotions. In all conventional modes of architecture, therefore, there can never be agreement; simply because different persons have adopted different symbols to represent those elementary affections of which beauty is the resultant. It is futile, therefore, to dispute about the relative merits of particular styles; for each will appear beautiful just in the proportion in which the spectator has learned to associate it with some social or selfish affection, and that is the most beautiful to each person which pleases him best.

The tenor of these remarks will probably appear to some of our readers to savour of the heresy that there is no such thing as good taste in architecture at all, and that it must be hopeless to advance in an inquiry where everything appears to rest on the caprices of fancy. Those, however, who have attended to our former remarks on these subjects, will perceive that such a dogma as this is opposed to the fundamental articles of our faith; but as the probability is that the persons who may read what we are now writing, have either forgot, or never seen, our former expositions, we shall here set down a few rough hints, to mitigate the regret of that deprivation.

There are two classes of associations with which every creator of beauty has to deal; and he must address himself to the one or the other, in the proportion in which he aspires to wealth or immortality. The first class springs out of the habits, prejudices, and sympathies of his own age and nation, and is affected by the quality of the literature, the tone of religious feeling, and even by the political relations of the time. The second class is composed of associations which are universal and immutable, though weakened and obscured at times by accidental causes, and have their origin in the fundamental laws of human nature. The first class of associations is that which is chiefly to be dealt with, when the aim is to become a popular architect for the time being: the second, when the ambition is to earn a fame that will last through future ages. We do not pretend to determine which of these aspirations is the preferable one, nor is it necessary, indeed, that we should offer any opinion on the subject, for it is the happy prerogative of the present age that it may attain both objects by the self-same instrumentality. The popular taste has long oscillated between the Grecian and the Gothic styles, the first being the fondling of one age, and the second of the age succeeding. But this antagonism has at length brought about a state of quiescence; and we are satisfied that no species of architecture would now be more popular than one which was clearly altogether of accidental associations, and addressed itself to the emotions which obtain among all men in all ages. This circumstance, it must be observed, is accidental merely to the condition of the time, and is by no means a necessary result; for in particular states of the public feeling, the very vices of a style will heighten its popularity. But we do not believe that such would be the case at present, and the question we have to resolve is, therefore, narrowed into the determination of those principles of design which will continue to give pleasure through all generations.

It has long been felt by architects, and indeed by every one who has given the least attention to the subject, that the pleasure of which architectural works are productive, is referable to a few elementary emotions, suggested by certain physical qualities. These qualities are usually defined to be—Fitness, Harmony, Proportion, and Decoration,—a definition, in the justice of which we cannot say we entirely agree, inasmuch as it appears to us to leave some important elements wholly out of the account, and to enumerate others twice over. Thus, for example, the emotion of Sublimity, to which many an edifice owes all its attractions, cannot be excited by any of the qualities included in the definition: and the quality of Proportion, again, if analysed, will be found to be merely the perception of Fitness;—not the fitness of science, however, but of the imagination. We therefore feel inclined to reject the received definition in favour of one which reduces architectural excellence to the exhibition of the qualities of Fitness, Magnitude, and Decoration. Harmony, indeed, is a thing that must not be wanting; but Harmony is not so much a physical property of itself, as the absence of disagreement in the expression of physical properties. Harmony, in short, is the police of Beauty, and its power lies not in raising primary emotions, but in taking care that the emotions raised shall not, by a vain contest, exterminate one another.

It will be obvious to the most cursory reader, that the Harmony we here mean is not the harmony of the senses, but of association. The harmony of colours, and of sounds, is, there is every reason to believe, a distinct physical property, which affects the eye, or ear, in some similar way as flavours affect the palate. It is by no means impossible, too, that the recurrence of certain lines, or figures, at particular intervals, may affect the eye in a way similar to that in which a particular quickness or collocation of vibrations is known to affect the ear; and, indeed, the polariscope has adduced many reasons for believing that such is the case. But these varieties of Harmony have little or no place in architecture; and, indeed, they have no more right to come under the same denomination with the Harmony we have defined, than the intellectual faculty we call taste has to be classed with the organic perceptions of the palate. A vast deal of obscurity is often scattered over such subjects, by the necessities arising out of the poverty of language, which compels the application of the same names to different things, and it is very important to guard against the misconceptions which flow so abundantly from this source of error.

We described in some detail, on a former occasion *, the process by which the perception of Fitness, Magnitude, and Richness of Decoration, becomes capable of affecting the mind with emotions of Sublimity and Beauty. Into that question it would be superfluous again to enter, but we may here inquire whether the qualities we have indicated are those from which, in ordinary cases, the sense of architectural perfection arises. This is only to be determined by a reference to those architectural works which have commanded the admiration of all men, through countless ages, and ascertaining whether the qualities to which they owe their power are identical with those that we have specified. We willingly avail ourselves of Mr. Moore's assistance in the accomplishment of this task, and here introduce some of his very able expositions to the notice of our readers.

"With this brief mention of a few points in architectural composition, let us endeavour to trace in certain buildings erected under the influence of different styles, erected at remote periods, the *peculiar* arrangements and forms which have called forth in the minds of their beholders, during *several ages*, the *like* sensations of pleasure and satisfaction. The question requires no introductory or historical details of architectural progression; no particular description of remaining antiquities; nor any theories as to the origin of different styles. Let us, then, commence our investigation by a reference to one of the most extraordinary structures that was ever raised by human means—the great Pyramid of Gizeh, in Egypt.

"Although we are not, perhaps, to look to Egypt for the *very earliest* specimens of ancient art, yet the grandeur and extent of its buildings sanction its claim to be considered as the oldest school in which a distinct arrangement can be marked, or a system deduced from existing examples. The remoteness and obscurity of its fabled annals, the mystery and gloom of its heathen superstitions, and the powerful oppression of a despotic government, have transformed its whole history into a tale of wonder, which would have but little claim on our belief or our sympathies, but for its connection with divine literature, and the mighty and enduring monuments that seem to have taken an everlasting root in its soil. Among these, and in some respects the most remarkable, are its *pyramids.* These immense masses of stone, with square bases and inclined sides, have been objects of interest and inquiry from the earliest ages. The time of their erection seems to be unknown; for, although surmises and opinions are not wanting upon the subject, yet nothing has been collected to which we can refer as authentic data. Their existence, however, may be traced to a very remote period, for they were objects of interest and research to Herodotus, the father of profane history.

"We have said, that a peculiar class of sensations are produced in the mind by the impression made on the senses by certain external objects.

"The base of the great Pyramid of Gizeh is stated to be equal to the area of Lincoln's Inn-fields, and its height one-third more than that of St. Paul's Cathedral. Now, let any one picture to himself the image of a bulk of solid stone, of the above dimensions, and he will immediately experience, to a certain extent, those feelings which we have endeavoured to describe as *sublime.* They may not be *powerful*, because they are produced by *secondary* causes; by the *imagination* of the object, and not by the object *itself.* If, however, the eye is steadfastly fixed upon the extent of area named, and a figure is awakened in the mind of such a portion of space occupied by a body, rising to the height we have stated, a degree of interest and excitement will be immediately called forth, very different to that state of calmness and repose with which we view objects of common occurrence and of usual magnitude; and we intuitively feel that the *reality* of the image would increase these effects in a very considerable degree. Now, then, what are the causes of these strange and peculiar feelings?—are they produced by the *shape* or *outline* of the figure? Certainly *not*, because we can conceive a pyramid of similar material, and of like form, but with a base only covering a few feet of ground, and no such results ensue. The object is an isolated one; it has no connecting or adjacent parts to give a character or qualities to the whole. It is a plain, simple, unbroken mass, without adjuncts of any kind, and yet we are affected in a remarkable degree, not only by the *sight* of it, but even by the *image* which a description of it will produce.

"It will, perhaps, be said, that the figure is calculated to impress us with a notion of *stability*, which may have some share in the effect. This, to a certain extent, it perhaps true; the form is evidently one of great firmness, and adapted for preservation and endurance; but if it does interfere with the emotions excited, its powers are but *secondary;* for in the image of the *reduced* pyramid to which we have just alluded, the same equality exists, but its importance it not striking or definite.

"It would seem, then, after mature consideration, that we must ultimately refer to the *unusual magnitude* of the object for the *effect;* and this solution will be borne out by the analogies which we can trace under different views and circumstances.

"Let us, for instance, take a fence wall, two hundred feet in length, and of the usual height of ten or twelve feet; we have been in the habit of looking upon such erections from our childhood, and we neither see nor feel anything extraordinary in their appearance. But suppose it to be raised to a height of two hundred feet, it is most probable that, when we view this vast increase of dimensions, our feelings will be suddenly and sensibly affected. The wall is considered to be without projections or ornaments of any kind; an entire plain surface, producing no interest to the beholder, while remaining at a usual and moderate height; but becoming an object capable of exciting *sublime* emotions, when extended far beyond those limits to which the mind has been long inured and accustomed."

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* See the Philosophy of Architecture in the Fourth Number of the *Artizan.*

It is not, however, so much by absolute as by relative magnitude that the emotion of sublimity is awakened. A mountain of greatly superior height to the wall Mr. Moore has mentioned would fail to call up any sublime emotions, simply because we are already familiar with mountains of that size, and consequently look upon them with indifference. Mr. Moore further lays it down, as a condition of sublimity, that all separation of the whole into parts shall be avoided: but this canon must, we conceive, be accepted with some reservation; for there is a sublimity of number, as well as a sublimity of extension, and the former kind will be heightened, instead of dissipated, by an increased subdivision. The manner in which a vast complication of details gives rise to the emotion of sublimity, is obviously by fatiguing the comprehension with their intricacy and number, and bringing upon the imagination an oppressive sense of infinitude. In this way extreme plainness, and extreme complication, may have their end in the same class of emotions—the one quelling the spirit by its austere and awful majesty, and the other bewildering the imagination by the number and variety of its combinations.

It would appear, then, that the proximate cause of sublimity in architecture is due to the quality of extension or complication, the ultimate cause being, no doubt, the suggestion of overwhelming power, which it would be vain to cope with, and impious to resist. The emotion of Beauty is a more complex one, but would appear to be compounded of Sublimity and the suggestions of Ornament and Fitness, mingled in ever-varying proportions. We may here, again, take an example from Mr. Moore.

> "Let us now refer to a building erected some centuries subsequent to that to which we have just alluded, and one, perhaps, of the most magnificent specimens of architectural design that has ever been produced in ancient or modern times—the PARTHENON, at Athens. It is not the province of this essay to enter into any particular description of the edifice, because it is generally known and enthusiastically admired by all persons who have a taste for architectural pursuits, or who take an interest in the remains of Grecian art. We shall, therefore, merely observe that it was a Doric, peripteral, octastyle temple, situated on the acropolis of that city, and erected in the time of Pericles, about four hundred and forty-eight years before the Christian era. It had a pediment, and eight columns at *each* end, with fifteen on either side; and, in addition to these *external* ones, there were likewise ranges of *inner* columns, which formed the pronaos and posticum. The cella itself is supposed to have been *hypæthral*—that is, a central portion of it was open to the sky. The several details are ably described and delineated in Stuart and Revett's Antiquities of Athens.
>
> "We have already stated that the distinguishing feature of this most remarkable building is generally described as *grandeur* of a great and masculine description. The Doric ordinance of which it is composed, and the several parts of that ordinance, although in exquisite proportions, are at the same time ponderous, and indicative of vast firmness and strength. The columns support very heavy superincumbent masses, which, although rendered beautiful by decoration, still preserve the character of immense pressure and density. The material of which the edifice is built being stone, requires short bearings in a horizontal position, and the spaces between the columns are, therefore, comparatively small, while the columns themselves are numerous and gigantic. The external lines are *continuous*; there are no breaks, no reduction of *large* portions into *small* ones, but the whole appears one mighty fabric enriched in parts, but yet preserving its majestic character from the maintenance of its enormous weights by proportionate supports. It must also be kept in mind that, although the dimensions of this building are not to be compared with those of the Egyptian temples, and, therefore, less likely to produce effects of the same *intensity*, yet they are sufficient to excite them in a certain degree, and to increase those we have just described. Under these considerations, may we not perceive that the consciousness of great power and strength called forth on an inspection of the Parthenon is similar to that which is felt on viewing the Pyramid of Gizeh, or the Temple of Apollinopolis Magna; that, although the causes are *different*, the results are the same, and that these results are *certain* and *alike* upon all minds, varying in force but constant in principle? It may be said, perhaps, that although the difference in magnitude between the Egyptian pyramid and the Greek temple may account for a variation in the intensity of their separate effects, yet the *amount* of this variation is not in proportion to the assumed principle. We must, however, remember that sublimity is the *only* sensation we experience from a sight of the former; but in the latter it is combined with a perception of beauty, which necessarily modifies its power."

This is, in our eyes, just and satisfactory. The emotions of Beauty and Sublimity are by no means inconsistent ones, but in proportion as Sublimity preponderates, the resulting emotion assumes an austere and masculine character, in which, nevertheless, the quality of Beauty is still preserved. Buildings, as they become more florid, should lose a corresponding amount of their massiveness, provided the decorations employed be intended to excite ideas of grace and beauty, and not to overwhelm the imagination by a maze of intricate combinations.

We cannot extend these remarks farther, and must here close them: yet, before dismissing the subject, we desire to repeat, that the grand secret of success in design lies in the excitation of such emotions as are not inconsistent with one another. Sublimity and gaiety are no more reconcileable than the face of a Venus with the figure of a Hercules; and any architectural work must be unsuccessful which appeals to such contradictory emotions. Whatever kind of beauty the general design of the work appears calculated to produce,—whether awful, voluptuous, graceful, or airy,—should be preserved in all the ornamental details; and the final emotion should always be such as to be in keeping with the purposes of the edifice. Good sense, is the first quality of every design; the next is, an agreement of the intended expression with the uses of the building; and the last, the agreement of the constituents of that expression with one another. In the words of Mr. Moore—

> "These *principles* are *immutable;* they are entirely separated from those dogmas and opinions which are often the pride of one age and the derision of another. He who studies them *well* and *truly*, with a mind sufficiently refined to appreciate their value, and with firmness enough to submit to the trammels they sometimes seem to impose, may rest secure in the hope of acquiring for his productions that popularity which neither fashion or prejudice can shake, nor time destroy."

ART. XII.—MAXTON'S JACKETLESS SLIDE.

THIS is a great improvement upon the common slide. The nature of the plan may be conceived by supposing a steam port to be situated above the under and beneath the upper ordinary port of the cylinder, and midway between these a port to be placed communicating with the condenser. The valve is so devised as to establish a connection between the middle port and the top and bottom port alternately; and when the bottom port is in connection with the condenser the top port is in connection with the steam, and *vice versâ*. There is a small excess of pressure between the antagonistic forces of the vacuum and steam to retain the valve up to the face; and as the valve does not require a jacket, it may be removed, and the faces re-ground with great facility. The plan is one of the most ingenious and most useful that we have seen for many a day.

ART. XIII.—THE ARTIZAN AND THE RAILWAYS.

IN routing out the nest of monopoly brought into being by our railway system, and showing in their true colours the tyranny and extortion of which that monopoly has been productive, we are generally conceived to have rendered some service to the cause of humanity and justice. It required little penetration to foresee that the performance of this service would bring us into collision with those who are interested in the perpetuation of the abuses complained of, and who will naturally feel sore at our expositions just in the proportion in which they are effectual. With this party we have no ambition to commence hostilities, though we shall not decline the conflict if we see strength enough arrayed against us to prevent it from becoming an ignoble one. But in the mean time we would desire to address a few words to those who, without having any direct interest in the railways, nevertheless advocate their cause, in the honest though mistaken belief that they have been conducive to the public welfare. The grandeur of most of the railway schemes has dazzled many a mind into a belief of their advantage; and the benefits of a rapid locomotion are so conspicuous, that they appear to have thrown into shade the inquiry whether it is not too dearly purchased. We may here give a specimen of the objections brought against our former remarks, which will enable us to answer them more specifically:—

> "There is one paper, however, in this month's *Artizan*, in the opinions of which we do not quite coincide—viz., that on 'Steam-coaches on Common Roads.' In the first place, we do not agree with the author in his bold assertion, that 'railroads (even in their present condition) have been an injury instead of a benefit.' There is no doubt that their establishment has thrown many coaches off the road, and destroyed the traffic of many a hamlet, but we ask, would not the steam-coach, so scientifically described in the *Artizan*, have the effect of creating a mighty revolution and a ruin to horse, cab, and omnibus proprietors? In our humble thinking, then, the village and the 'von oss shay' should be sacrificed to the vast utilities of our railroad system. Let us have the steam-coach by all manner of means, but, by our lady, don't annihilate the Great Western Railroad. In all such enterprizes the golden rule of conferring 'the greatest good on the greatest number' must never be forgotten."

To this golden rule we assent most cordially; and it is precisely because the railway system sets it at nought, that it has come under our reprobation. It is not because railways have driven cabs and coaches off the road, ruining hamlets and involving multitudes in beggary, that we condemn them; for, if a greater benefit had been conferred than the injury inflicted, we should have been willing to strike a balance and give the railways credit for the difference. But we maintain, that while the injury has been positive and extensive, the benefit has been inconsiderable—extending no further, indeed, than the acceleration of an acceptable mode of transit to that small number of persons who can afford to pay for an expensive mode of conveyance. For these reasons, we repeat that the railways in this country have been an injury instead of a benefit; and, without pretending to go far into the subject, we shall scatter a few remarks—sufficient, we trust, to shew that our assertion was not lightly uttered.

There are two aspects in which the railways may be viewed—the first, as an instrument in the amelioration of the country; and the second, as a commercial undertaking. These relations are intimately connected, but they are, nevertheless, sufficiently distinct to admit of their being separately considered. And as regards the first, we may remark that railway locomotion is too expensive to be acceptable to the *great majority* of the community. By temporarily lowering its fares, a railway may always drive the old mode of conveyance off the road, thus creating a monopoly, against which it would be hopeless for individual enterprise to contend, and all the exactions, of which the public has no alternative but to suffer. The indignities heaped upon passengers who are unable to go to the expense of first-rate carriages—the inconveniences to which they are purposely subjected, and the dangers to which they are purposely exposed, we have adverted to on former occasions, and need not now repeat; but the effect of all these oppressions is to make the poor man sigh for the stage-coach, and even the stage-waggon, of times less violently locomotive, and which have been driven from the field by these cruel refinements. It will be objected to this doctrine, that if the exploded conveyances were those really preferred, they would have continued to flourish, though, perhaps, in a diminished number; but any such inference we believe to be fallacious, for no coach-proprietor would be rash enough to start an opposition to a railway, when he knew that the next week, by lowering its fares, the railway might drive him off the road, and render useless the whole of his expensive establishment. It is the policy, indeed, of the railways first to overcome all opposition, and, having the public in their power, to make of that power a most extortionate use. We do not for a moment deny that railway travelling is very delightful and commodious to those who can afford to travel in the more expensive trains; but we do say, that upon that far larger number whose means are limited it weighs with a heavy oppression, and that, if tested by the golden rule of the greatest good to the greatest number, it must be pronounced an injury instead of a benefit.

The commercial aspect of the railways is not in the least a more favourable one: out of a list of *forty* railways now before us, we find there are only *eight* paying a dividend of more than 5 per cent., and only four paying a larger dividend than 6 per cent., while a large proportion are paying only 1, 2, and 3 per cent., and a considerable number of them nothing at all. Commercially, therefore, railways have been a bad speculation, and not only have they been productive of loss to the parties immediately concerned, but by withdrawing capital from other investments while the railway fever was still in the ascendant, they contributed to heighten if not to produce the distress which has lately pressed upon the great body of artizans with such dreadful severity. And yet we are told that the railways have been beneficial! as if any commercial scheme could be beneficial which did not pay. The effect of the railways has been just the same as if vast quantities of wealth had been thrown into the sea, and we think it needs little logic to show that such a disposition of property is an injury rather than a benefit. Here, however, for the present, our space compels us to pause—and we pause in the hope that our position may be further assailed, for we know of no experiment by which it may be more clearly shown that it is impregnable.

Art. XIV.—GRAY'S FIRST EPISTLE TO THE ENGINEERS OF THE UNIVERSE.

Beloved,—I have been telling Sir Jonah, for a good while past, that it was absolutely necessary, and, furthermore, only right and proper, to have some papers put in, explaining, clearly and simply, the whole theory and practice of the steam-engine from beginning to end. It is all nonsense, in my opinion, to be putting in long screeds of algebra; for what working man will bother his head about juggles of that kind? No, no; it is plain sense and plain addition and multiplication that is wanted in explaining the steam-engine to workmen; but Sir Jonah is all after the high flown system, and maintains that skilful engineers, such as Mr. Field and Mr. Miller, would laugh at us if we were putting in o' wheen a things that they, and all such as them, ken about already, and which, consequently, could convey to *them* no new idea. Howsomever, after much ado, I have struck a bargain with Sir Jonah that he, and the lave of the skilly ones, are to write for masters, and that I am to write for the men. Having come to that agreement, I will now tell you what I am going to do. I mean to begin at the very bottom of the subject of steam-engines, and go on with them right through, so that my remarks will form a continuous treatise, and every one reading them will become as knowing about steam-engines as I am myself. I shall first take the subjects of Heat, Steam, and Combustion; then the mechanical principles involved in steam operations; afterwards I shall give an account of the best modes of constructing all kinds of steam-engines; and, finally, give rules for finding the dimensions and strengths of all the parts. I mean to show all these things without introducing anything more difficult than multiplication and division, and whoever knows common arithmetic will be able with ease to follow me. I know that you will be very grateful for this, my public spirited design, but you may spare your thanks, for I am always willing, and, indeed, feel a pleasure in pouring out my knowledge for the benefit of all who are disposed to listen.

I am, Beloved,
Your devoted brother,
A. Gray.

Art. XV.—MONTGOMERY'S FIRST CANTICLE.

THE VISIT TO MY NATIVE TOWN.

Long years of roaming past, my native town
Again I saw. How changed was all! Schoolmates,
Whom I had left trundling the hoop, intent
On tops, and balls, and marbles, and like sports,
Were grown to manhood. Some with early care
Marked on their brows, mindful alone
Of Mammon's pelf; and some, low grovelling
In Epicurus' sty, fed from the trough
Of sordid vice their swinish appetites.
And one—the best belov'd—with whom I oft
Had held sweet counsel; or, to sport inclined,
Had climbed adventurous the old castle walls,
With matted ivy overgrown, and, spite
Of perilous falls, each nook explored, and pierced
Its dungeons dim, and subterranean vaults,
Much marvelling to ourselves at olden times:
Beloved companion of my boyish sports,
He did not live to welcome my return.
Through the old churchyard's precincts as I strolled,
Gazing on past memorials and on new,
His gravestone sudden caught my eye,
Close to the very spot—that huge square slab—
Whereon in bygone times we frequent sat,
Striving to trace its worn-out characters,
And in our boyish fashion moralised
On life and death, time and eternity.
Nor did I pass thy grave neglected by,
Nipped in the bud of being though thou wert,
My infant brother! On the Sabbath day,
Or when, with palsied hand, the sexton scooped
Another pit for frail mortality,
Then through the opened gate I sought the spot
Where lies thy ashes; though unepitaph'd,
Without a stone even to mark the place,
Yet known to me by well remembered signs.
My dear young brother! beautiful thou wert—
Most beautiful and good—and wise beyond
Thy years. How, with a father's loving pride,
I watched with ecstacy each dawning thought.
But Death—the envious churl—with wintry breath,
Blighted the bud of promise in its birth;
And left me like some gardener, who at morn,
Pacing his grounds to mark how thrive each flower,
And fruit, and shrub, stands sudden all aghast
As he espies his choicest pride, the work
Of many long pains-taking hours, laid low.
Thus, but more deep at heart, mourned I my loss.
A stranger in my native town I stood,
Surrounded by unsympathising hearts—
That worst of solitudes—no kindred soul
Kindling with thoughts responsive to your own.
Most things were changed; the persons much, and much
The place itself was changed; but the old house—
Home of my infancy and boyish days—
Remained the same, though falling to decay.
Most dear to me was that old house! though not,
As poets love to paint, a low thatched cot,
With creeping plants o'ergrown, and redolent
Of roses, with a rill soft gliding by.
A plain brick building in the crowded town
It stood, wedged tightly in, and frowned upon
By lordly mansions, which held high their heads
Above its lowly roof with proud disdain.
Yet dear, most dear, to me was that old house!
Though tenanted by strangers, and no more
A home to me—it had been once a home,
And wore a pleasant smile, like some old friend
Met sudden in the bustling walks of life,
Much buffetted and careworn it may be,
And sorrowing, yet with a flush of joy
Upon the cheek, and kindling of the eye,
As hand grasps hand, and welcome welcome meets,
And the heart throbs with thoughts of auld lang syne.
And there were still my much loved haunts of youth,
Endeared to me by thousand tenderest ties.
Thou Exe! along whose banks I oft had strayed,
And in thy limpid stream the summer's heat
Assuaged—thou still did'st roll in beauty on;
Now hid in shade; and now unto the sun
Thy glad waves flashing; now with gentlest stir
Gliding along so languidly, as loath
To quit the fairy scene; and now again
With sudden rush chafing thy pebbly bed,

As fretted into rage: how like to life,
With all its calm and tempest, joy and grief.
And on thy bank still stood that uncouth tree—
With its two limbs flung, like a madman's arms,
Grotesquely out, o'erjutting far the stream
That washed its roots—within whose boughs I framed
A rough-hewn seat; and there, when holiday
Threw ope the school-room door, and let us loose,
A boisterous throng, tired of rough sports, I oft
Withdrew into my leafy hermitage,
And hung enraptured o'er some marvellous tale—
But chief the poet's song held me enthralled.
There sat I oft, with nature's charms delighted.
Through the thick twinkling canopy of leaves
Brief glimpses of the azure sky I caught,
Momently come and gone. Beneath, the stream,
With sweet sad murmur rolled its gentle course,
From spray to spray quick darting, nature's bards,
The winged warblers, trilled their songs of joy.
Their little frames quivering with ecstacy.
And ever and anon came on my ear,
Heard faintly, some far-off halloo, or peal
Of laughter from my merry mates, as they
Untiringly kept up their various games—
Of football—hunt the hare—or prisoner's base—
And all the many pastimes boyhood loves.
I climbed again that aged tree, and sat
Upon the seat that, ten long years ago,
I formed; there, too, my name, rough cut, remained;
And then I thought within how many minds
That knew me once my memory was effaced—
Like prints on sand, gone with the coming tide.
Ah! happy boyhood! like refreshing dew
Thy memory sinks into the withered heart;
And joys, which long have bowed their heads to earth,
Crushed in the pitiless storm of life, once more,
Beneath thy balmy breath, spring gaily up.

Art. XVI.—AVANTURINE GLASS.

Avanturine glass is a species of brown glass, full of small metallic spangles, which in former times was in great request in the manufacture of the numerous ornaments for which Venice was celebrated. The revolutions of fashion many years ago put an end to the demand for it in any large quantities, and as the mode of composing it had always remained a secret, the art became extinct. In a late number of "Jameson's Journal," Professor F. Wohler gives the result of a careful analysis of this interesting substance, by which it appears that 100 parts of it contain:—

Silicic acid, with traces of tin	65·2
Phosphoric acid	1·5
Oxide of copper	3·0
Oxide of iron	6·5
Lime	8.0
Magnesia	4·5
Soda	8·2
Potash	2·1
Alumina and sulphic acid	·1
	100

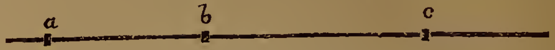
It would thus appear that Avanturine glass is an ordinary glass, which owes its peculiar appearance to copper, probably in the form of a protoxide.

Art. XVII.—PROMISCUOUS NOTES ON ARCHITECTURE AND BUILDING.

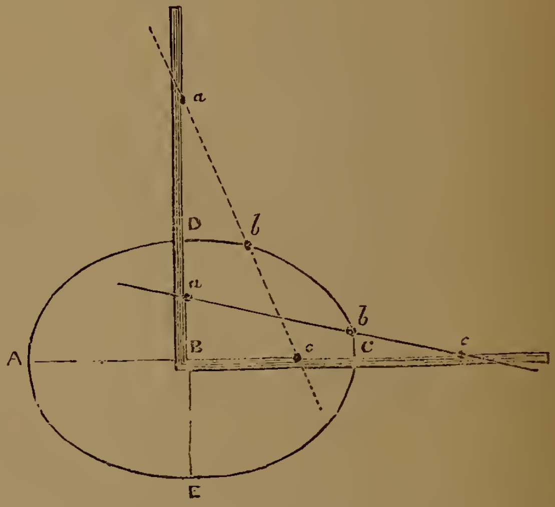
Proportion in architecture signifies fitness, but, as we have elsewhere remarked, it is not the fitness of science but of the imagination. We mean by this that there may be a true proportion in engineering which is not a true proportion in architecture; the former being the deduction of science merely, and the latter in a great measure the product of fancy. Thus a light iron column may be strong enough to support a very heavy structure, and its proportions be consequently scientifically true, but may fail nevertheless to satisfy the eye, because the imagination, in spite of the judgment, suggests its insufficiency. The materials with which the imagination works are experience and analogy; and the experience of heavy stone columns in such situations as that in which the cast iron is employed, and the analogies of the animal and vegetable creations, conspire to make the lighter proportions appear wrong, though known to be right.

There are various methods of describing an ellipse upon a plain surface; we may observe, however, that the trammel in common use is very defective, inasmuch as it will neither describe a very small ellipse, nor such a one as approximates nearly to the circle. We have seen an instrument invented by Mr. G. Ridley, which overcomes this defect, and appears to answer all ordinary purposes; by it the smallest ellipse may be formed, and those approaching near to the circle, or even the circle itself, may be described with the greatest facility and exactitude.

The instrument consists of a beam having three sliding sockets, which are fixed at any distance from each other, by means of screws, as shewn by Figure 1.

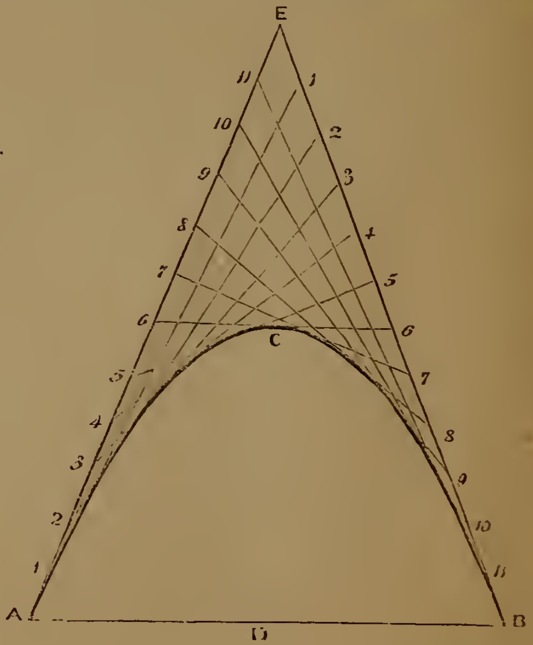


On the sockets *a* and *c*, small sheaves are made to work on pins attached to the sockets; to the socket *b* is fixed a tube for the reception of a pencil or tracing point. The centres of the sheaves on the sockets *a* and *c*, being in a straight line with the tracing point on the socket *b*, the length of the beam may be made to answer any description of ellipse. The mode of using the instrument is shewn by Fig. 2.



Let A C be the length of the ellipse, and D E its width, the major and minor axes intersecting each other in the point B. Let the inner edges of a square be laid in the position of the lines B D and B C, at such a parellel distance therefrom as to allow the centre of the sheaves on the sockets A and C to move immediately over the middle of the lines B D and B C; in fixing the position of the sockets, make *a b* equal to half the length of the ellipse, and *b c* equal to half its width; then, by moving the beam as shewn by the dotted lines, the tracing point will describe one quarter of the ellipse, each of its remaining portions being described in a similar manner, taking care while the beam is in motion to keep the sheaves on the sockets A and C, close to the inner edges of the square.

We may here give the usual mode of forming the parabolic curve for practical purposes. Let A B, Fig. 3, be the width of the base; D C its height;



make D E equal to D C: join A E and B E. Divide the lines A E and B E into any number of equal parts, say twelve to each. Let the divisions thus made be numbered from 1 to 12, as shewn in the figure. Join the numbers 1, 1, 2, 2, &c.: the lines thus drawn will form the tangents to the curve, and the curve itself is obtained by drawing a line which touches all the tangents.

ART. XVIII.—PROMISCUOUS NOTES ON STEAM MACHINERY.

Stuffing Boxes.—A great economy in the tallow usually required for stuffing boxes is effected by encircling the rod by a piece of sheet brass, the joint being a diagonal one, and the bottom edge turned up all round like the brim of a hat. This brass tube is packed with hemp at the back, and extends from the bottom of the stuffing box to within three-quarters of an inch of the top, so as to admit of the gland being tightened, and the upper edge of the tube is bevelled off, so as to prevent the packing from catching upon it. This improvement is due to the engineer of the Tagus, in which vessel it has been in successful operation for many months past; its effect is to keep the piston rods in the best possible condition, and to effect a saving of three-fourths of the tallow.

ART. XIX.—THE SOCIETIES.

French Academy of Sciences.—A paper on the application of ammoniacal salts as manures, and on their probable mode of action in promoting the growth of plants, was read by M. Boussingault, at the sitting of the Academy, on the 30th of September. He contends that no combination of ammonia other than with carbonic acid, or with some of the vegetable acids, is beneficial as manure. In certain states of the soil, however, when there is just sufficient moisture, he finds that the other ammoniacal salts become converted into carbonate of ammonia, which is generally admitted to be an excellent manure, for in that state vegetables absorb the carbon, hydrogen, and nitrogen, of which the carbonate is composed, and those elements are assimilated into the constituent parts of plants. An Artesian well, compared with which the one at the Abattoir of Grenelle, in Paris, appears insignificant, is in the course of construction at New Sabzwerck, in Westphalia. It appears, from the statements made to the French Academy, that the bore has already been completed to a depth of 650 metres, which is equal to 710 yards, and it is intended to sink it to a depth of 2,000 metres. The object in this case is not to obtain water for drinking, but to procure an ever-flowing salt-spring, as it is estimated the salt works will be found at that depth, and that the water which rises will be saturated with salt. The bore has already reached 600 yards below the level of the sea. The water, when it rises from the lowest depth to which it is intended to penetrate, will, it is expected, be of a temperature nearly equal to boiling water. At the same sitting M. de Mapas mentioned that, in taking pictures with the Daguerreotype, he discovered a second image formed on the plate under the outer follicle of iodised silver. He was led to this discovery by having accidentally allowed the rays of an object to remain so long that the first fine crating of silver peeled off, and underneath he perceived another but fainter image impressed on the plate. Other investigations respecting the Daguerreotype formed the subject of a paper, read to the Academy, on the 9th of October, by M. Pinaud, who has performed experiments for the purpose of determining the effects of electricity compared with those of light. He ascertained that paper prepared with chloride, iodide, or bromide of silver, is more sensitive under the influence of electricity than of light. There is a remarkable distinction, however, between the effects of the two electricities. Negative electricity speedily blackens the prepared papers, but positive electricity restores the paper so blackened to its pristine whiteness; and even images formed on the paper by light are said to be removed when exposed to the influence of positive electricity.

ART. XX.—INVENTIONS OF THE MONTH.

Sea Alarums.—We noticed in the last number of the *Artisan* a proposed application of the power of the waves to propel ships: we have now to mention an application of the same force for the purpose of warning sailors of danger. The inventor is Mr. Hobbs, and his plan, so far as we can comprehend it, is to have a flat buoy moored to the bottom of the sea near dangerous coasts or sand banks, and to be fitted with pipes to which metal tongues are attached, on the same principle as accordions. The air admitted into and again forced out of these pipes, as the buoy is lifted up and depressed by the breakers, passes through the accordions and produces a loud sound, sufficient, it is said, to be heard above the commotion of the waters. There are other pipes to be fitted to the buoy which are to come into play only in very rough weather; and thus, as the dangers of the coast increase, the waves scream with a louder voice to the sailors to beware. The superior advantage of a sounding signal, if it could be brought into practical effect, would be its independence of the weather, for in the darkest night, and in the thickest fog, its warning voice would be heard when no beacon could be of use.

Machine for Raising Miners.—Many have been the contrivances for raising the men working in deep mines, which are not so perpendicular as to admit of the ordinary plan of a rope wound round a windlass, but none has been so successful as a machine recently constructed in the Trevescan mine, in Cornwall, promises to be. It consists of two rods worked up and down alternately, by steam power, and to which rods small platforms are attached at distances of twelve feet asunder. The rods at each stroke of the engine are raised and lowered six feet, so as to bring the man who is standing on one platform level to the platform on the other rod which has just descended. He then steps from one to the other, and at the next stroke of the engine he is raised another twelve feet; and thus he proceeds, stepping from one platform to another till he finds himself at the top, and without any labour. The lowest part of the mine is 240 fathoms, and from that depth the miners are raised by the apparatus in twenty minutes; whereas the climbing by ladders occupied nearly one hour. The cost of the machine was £3,000, but the saving of time and labour, it is calculated, will shortly repay the proprietors.

A Metal Finder.—A lieutenant in the Russian navy is stated to have invented a method of detecting metals at the bottom of the sea or rivers by galvanic influence. The plan he adopts is to allow the two wires from each pole of a voltaic battery to drag at the bottom. When they come in contact with any metallic substance the voltaic circuit is completed and the electricity acts immediately on a galvanometer, which shews by its deflection that some metal must be at the bottom. The immediate object to which this invention is to be applied does not appear, though we imagine the Russian intends to fish for gold in the auriferous streams of the Oural mountains.

Economical Printing.—A Frenchman has contrived a plan for printing a given quantity of words in type of a given size, within half the compass that the same words and type occupy in the common plan of printing. To do this he uses *half letters;* that is—letters of which the lower half is cut away. Letters thus bisected are indeed legible for all ordinary words, which may be known partly by the signification of the words preceding, but for proper names they would often be very puzzling, and after all the object may be effected quite as legibly by using smaller type.

Plan of Feeding Steam Boilers.—A method of feeding steam boilers has been contrived by Mr. Shaw, of Leeds, by which the boiler may be constantly supplied with water without a force-pump, or any other power than the mere gravitation of the water itself. The vessel in which the water is contained before it enters the boiler is an upright cylinder, which is placed with its lower end on a level with the water in the boiler when at its proper height. A circular wooden float fits the cylinder, but so loosely as to permit it to swim on the top of the water. Pipes from the top and the bottom of the cylinder communicate with the boiler; the one at the bottom entering the boiler below the water-level, and that at the top communicating with the steam. Another pipe from the cylinder communicates with the water-tank. When the cylinder is empty of water and filled with steam, the communications with the boiler are closed by stop-cocks, and a stop-cock on the pipe leading to the tank is at the same time opened. The steam in the cylinder is immediately condensed by the cold water, and a vacuum being formed, the water rushes in and fills it. The stop-cocks are then reversed; the communications with the boiler are opened, and that with the tank is closed. The float on the water in the cylinder being a non-conductor of heat, but little of the steam that enters at the top is condensed, and the pressure on the top and bottom being equal, the water flows into the boiler by its own gravity. The cylinder may be so placed that the water within it may be heated before the communications with the boiler are opened, and thus diminish the condensation of steam, and prevent the action of the boiler from being diminished by the admission of cold water.

New Safety Valve.—Innumerable have been the contrivances for improving the safety-valves of steam-boilers; and though we are aware that some of our most distinguished engineers think no further improvement is required, yet the not unfrequent accidents which might have been prevented by an efficient safety-valve, show that absolute perfection has not yet been attained. A contrivance by an ingenious American engineer seems to combine the advantages of a safety-plug with those of a self-acting valve, and to ensure escape of the steam when of a dangerous pressure. A perpendicular tube, closed at one end, enters the boiler from the top, and descends to within a few inches of the flue. Into this tube is placed some fusible metal, of such a composition that it will melt when the temperature of the water in the boiler, and consequently the pressure of the steam, is greater than is desired. One end of the lever that presses down the safety-valve is attached to an iron rod, which is fixed in the fusible metal at the bottom of the tube. Between the safety-valve and the weight is a prop, which is to serve for a fulcrum of the lever when the valve is put in action by the dangerous increase of pressure. For instance, when the temperature of the boiler becomes too high, the fusible metal melts, and releases the rod which held down one end of the lever. The weight then pulls the lever down till it rests on the prop between it and the valve, and the lever being attached to the valve, the latter is pulled out by the weight which, in the first arrangement of the lever, pressed it down. Thus if an engineer wished to load the valve more than the boiler could safely bear, the effect of adding greater weight would only be to ensure the more effectually the lifting of the valve when the fusible metal gave way. The composition of the fusible metal suitable for different temperatures and pressures is stated by the inventor in the specification of the American patent.

ART. XXI.—ANALYSES OF BOOKS.

Templeton's Engineers' Pocket-book for the Year 1844. London: Weale.

This is a judiciously compiled and useful work; to say that it is well got up in its mechanical details is needless, for the mere fact of its publication by Mr. Weale carries that assurance. We are glad to find that Mr. Templeton is a diligent reader of the *Artizan*, and can congratulate him on the judicious use he has made of the information yielded by ourselves and others. We recommend this pocket-book to all artizans who require such a companion, and can afford to obtain it.

Railway Contracts in France under the Administration of the Ponts et Chaussees. London: Simpkin, Marshall, and Co., 1843.

From the cursory glance we have been able to give at this pamphlet, it appears to abound in statistics of much importance as regards the comparative merits of the French and English railway systems.

ART. XXII.—MARVELS OF THE DAY.

The Great Northern.—We have visited this vessel since her late metamorphosis, and have been much gratified by the improved aspect the machinery now wears. The objectionable parts of it have been removed, and their places supplied by machinery upon a better plan, and we have no doubt the engines will now work satisfactorily and efficiently. The vessel, we understand, was lately tried, and a speed realized of about 9½ knots. This is a very high degree of speed, the magnitude of the ship and smallness of the engine considered, and adds another to the fast accumulating proofs of the efficiency and value of the screw plan of propulsion.

We owe the Great Northern something of an apology, for the somewhat truculent manner in which we were induced to speak of her in our first number. Our censures were, we feel, too severe; but they were the natural effect of the extravagant commendation with which the vessel was visited. Those who cry out against unmerited severity, must remember that there is also such a thing as unmerited praise; and in the case of the Great Northern our bitterness appears to have been necessary, to redress the inordinate eulogy lavished upon her in other quarters. But however this may be, the owners have little reason to complain of our exposures, as they naturally acted as a stimulus to redress the evils complained of; and those evils have certainly been very effectually extirpated. The alterations in the machinery do much credit to Messrs. Miller and Ravenhill, by whom they were accomplished, and the Great Northern is now an efficient serviceable vessel, and we may add a marketable one.

The Tagus.—This favourite steamer is now in the East India Dock, receiving a set of marine boilers on the locomotive plan, made by Messrs. Miller and Co. These boilers are of the same description as those now being put by Messrs. Miller and Co. into the Infernal. The engines of the Tagus are receiving a thorough repair.

FROM OUR OWN CORRESPONDENTS.

GLASGOW.—*Water Witch.*—This new iron steamer is the fourth this season has produced for the river passenger trade. She was built, and the engines made by Messrs. Caird and Co., Greenock; length of keel 123 ft.; over all 130 ft.; breadth of beam 16 ft. 4 in.; depth of hold 5 ft. 6 in.; draught of water, loaded, 2½ ft.; fitted with water-tight bulkheads.

This somewhat unique craft, though constructed by Clyde engineers to ply on the Clyde, scarcely affects the question of the respective merits of Clyde, and not Clyde steamers, because, though topographically a Clyde boat, yet, essentially and mechanically speaking, she has nearly as little claim to the title as the Little Western or the Great Northern. Instead of the favourite Colossus of Rhodes-like form of direct action engine—the steeple engine of Mr. David Napier—those of the Water Witch are on the diagonal construction, something similar to those of Edward Bury's river-boats for the south of France, the cylinders being inclined at an angle of about 20° with the horizon. The framing consists of 4 side pieces, or checks, which carry the crosshead slide bars, and paddle shaft, and is plain and so light that, to the eye accustomed to the architectural pretension of the *Clydo-gothic* framings, it seems at first sight insufficient. But the judicious disposition of the material, opposing direct resistance to the greatest strain, gives sufficient steadiness to a very slight fabric. Instead of one heavy engine, working at a moderate speed, and driving a paddle-wheel of large diameter at a great velocity through the water, there are two cylinders, 22 in. diameter, 4 ft. stroke, making 50 strokes per minute, with wheel only 10 ft. diameter, the circumferential velocity of which is so timed as to give the minimum of back water; each float board perceptibly leaving its own mark in the water. There is one foundation plate; one condenser; one air pump, wrought by a cranked intermediate shaft; one valve casing between the cylinders, the valves working back to back; four excentrics arranged symmetrically, two for the valves, and two to work the pumps; the strap working, wrought iron or cast iron, without the slightest tendency to heat.

The space occupied by the entire engine is 17 ft. 6 in. altogether below deck. Weight of engines 12 tons; two elliptical boilers of the usual construction, without tubes, weighing together 12 tons; water 8 tons; total weight 30 tons. Saloon on deck amply lighted, comfortably and elegantly fitted. Speed about 12 miles per hour.

Such is the Water Witch, sufficiently dissimilar, as those acquainted with the subject will perceive, from the ordinary run of river steamers on the Clyde. The smoothness with which the engines work at double the ordinary velocity, the plainness and correct taste, and mechanical arrangement of the whole, are perhaps rather more creditable than characteristic of the genus to which this specimen belongs. As for the general look of the vessel, though she cuts the water very smoothly, her entrance to our mind is rather too hollow for beauty, and scarcely sharp enough for speed. Perhaps we should be inclined to say that, on the whole, the vessel has an insignificant appearance, such as her actual dimensions do not justify—a fault which a judicious use of the paint-brush would go far to remedy.

The Engineer and Lady Kelburne.—The intended trial of speed between the Engineer and the Lady Kelburne was prevented by the engine of the former breaking down a few days previous to the appointed time, being the third and most serious breakdown that the Engineer has yet accomplished. Whether this proceeding was prompted by a self-sacrificing zeal for the good of trade, or a disinterested determination to avert the stigma from the *Artizan* of being a false prophet, has not yet transpired. But, as one of the most objectionable parts of the engine was amended after the second catastrophe, we believe the present "*renversement*" is at least rather to be considered as an accident than a blunder. Whatever be the character of the machinery, we believe the great point aimed at by the makers—speed—has been attained.

The Lady Kelburne ran the course on the day appointed, rounding Ailsa Craig, and returning to Greenock, a distance of 113 miles, in a heavy sea, and head wind out and in, in 8 hours and odd few minutes, being at the rate of 14 miles per hour. The same vessel, steamed from Brodick Bay, Arran, to the Broomielaw, encountering an impetuous flood on the river, in 4 hours 20 minutes, the distance being 60 miles.

New Iron Steamer.—Messrs Tod and Macgregor are building an iron boat for the Victor Steam-boat Company—very sharp—engaged to be the swiftest boat on the river.—125 ft. measured on the keel; 17 ft. 3 in. beam; 7 ft. moulded; about 70 H. P.; wrought iron engine framing; two locomotive tubular boilers, of great strength, containing each 130 ft.; 3 in. wrought iron tubes. Total weight of hull, machinery, and equipment, estimated at 45 tons. The locomotive plan of boiler we like, but we should have given the preference to cross tubes.

The Princess Royal.—This favourite steamer has been provided with two life-boats 28 ft. long, 6 ft. 2 in. broad, capable of holding 30 persons each. The space beneath the seats is built up with cork, similar to the life-boats that have been in use for many years on the east coast of Scotland. The four boats, with which this vessel is now provided, are sufficient to contain 100 people. It might be worth remarking, did analogous cases not frequently occur, that this expedient for averting the calamities from shipwreck should be first adopted in Clyde boats (so far as our information goes) by the very one least likely to stand in need of it.

New Signal Light.—The new signal light for vessels in distress, invented by Mr. Robinson, of London, which has been exhibited at Leith and elsewhere, was exhibited here with great success, on the evening of the 3d ult., from the centre of the accommodation bridge. The intense brilliancy, combined with the somewhat livid hue, shedding its unearthly beams on the massive buildings on each side of the river, reminds us forcibly of the glare of sheet-lightning in one of the most appalling thunderstorms we ever witnessed.

Mr. Robert Napier has fitted the river steamer Superb with a somewhat elegant species of oblique paddles, the patented invention of Mr. Chatterton, of Canada. Imagine each float to be cut in two transversely at the centre, and that the force required to accomplish this had, before sundering it, bent the float to the form of a very obtuse V, the one of the two adjacent ends being at the same time pushed a few inches past the other, and a pretty correct idea will be formed of the Superb's wheel. This is said to answer very well, and we do not doubt it; but it is almost needless to say at this time of day, that there is about as much invention in the matter as there would be in buttoning one's waistcoat a button awry, or turning one's coat outside in. If to patent an invention gives the appropriator an exclusive right irrespective of the question where or how he got it, we do not see why a certain ingenious class of handicraftsmen should not be allowed to *patent* the lining of every purse and pocket-book which, in the exercise of their calling, they may chance to *discover*.

MANCHESTER.—*Improved Trade.*—The improved condition of our staple business, the cotton manufacture, has, as a natural consequence, already produced symptoms of increased activity in various trades partially dependant thereon; foremost of which may be reckoned that of the machine-makers. Indeed, a few of the machine-making establishments in this vicinity have been pretty fully employed for the last two years, though chiefly for foreign orders. The general engineering, steam-engine-making, and millwrights' trades, have also participated slightly in this improved state of things, and partly from the same cause. St. Petersburg, Moscow, and Barcelona, are mentioned amongst others as recent destinations for steam-engines and cotton machinery. As yet the general building trades have had perhaps the least share in this onward movement. There are, however, some new cotton factories now in course of erection in this county, one of the largest of which is nearly finished, and will contain two eighty-horse high-pressure condensing engines, a modification of Woolf's principle. This mode of working steam expansively in two cylinders for cotton-mills seems likely to prevail. It has been partially used in this town for some years past, and would, no doubt, have been used more extensively but for the general unwillingness of manufacturers to risk boilers with 50 or 60lbs. pressure of steam in the close vicinity of their factories. Hitherto attempts to work steam expansively in cotton-mills have been generally confined to effecting it in the same cylinders, and at a comparatively low pressure, not exceeding 10 or 12lbs. per square inch, and, consequently (considering the low cost of fuel here), with very indifferent success. We are promised much illustrative information for the *Artizan* on this subject.

OBLIQUE ARCHES.

No. 2.

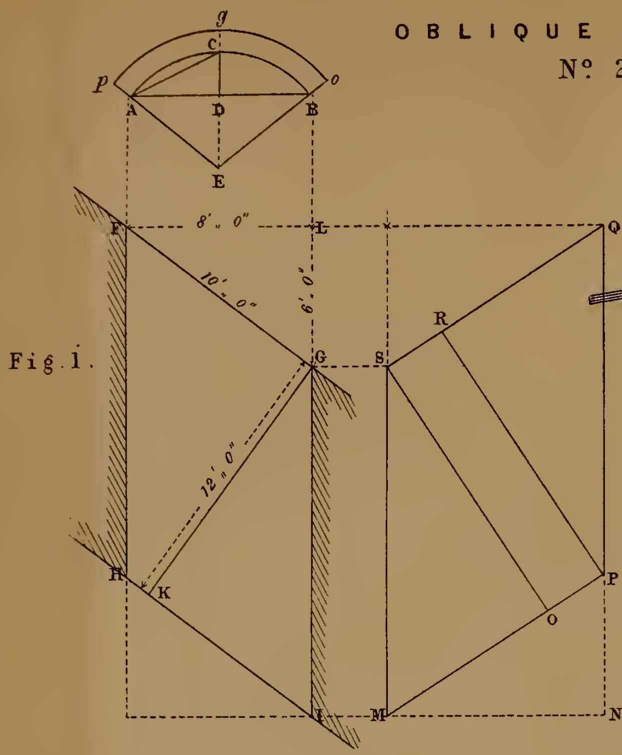


Fig. 1.

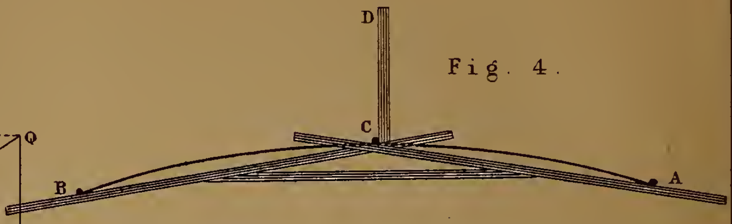


Fig. 4.

Mode of drawing the segmental curve of the Coursing moulds.

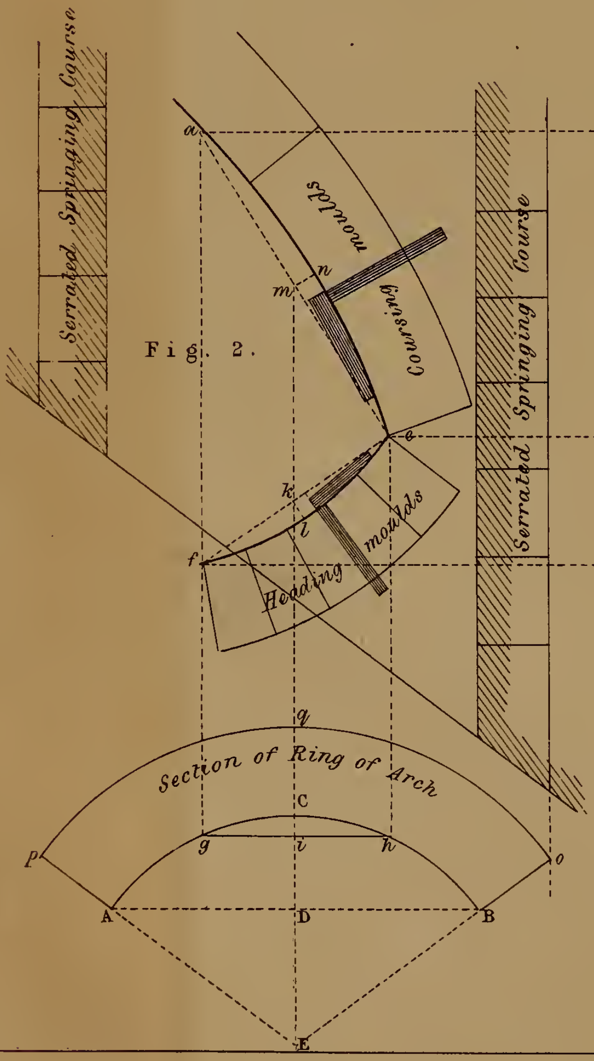


Fig. 2.

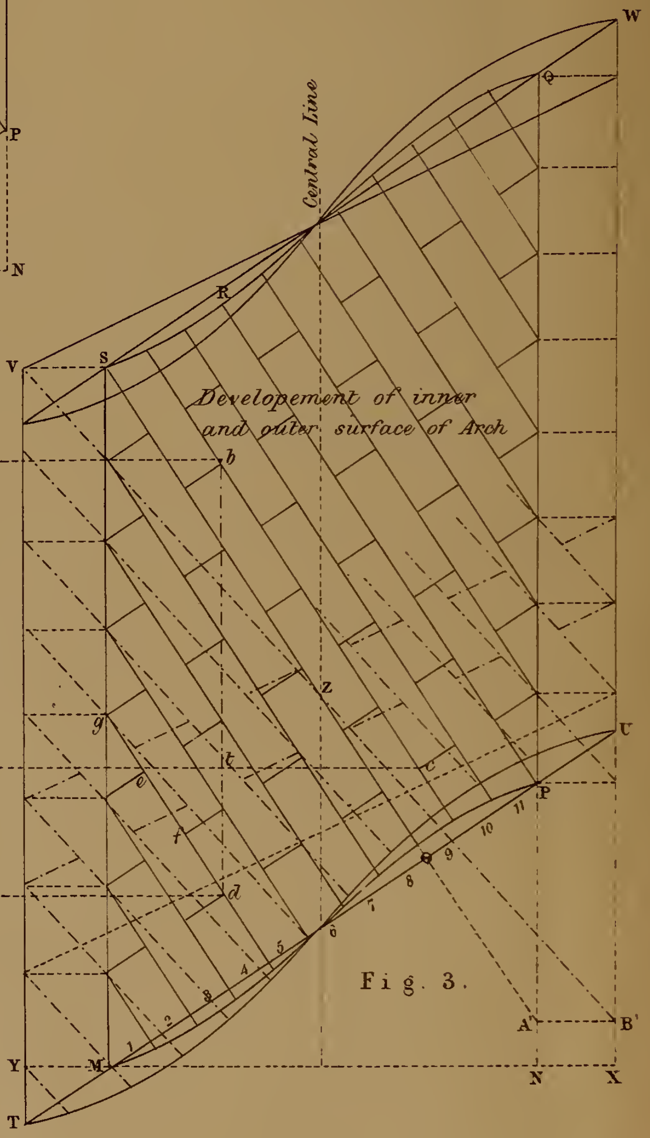
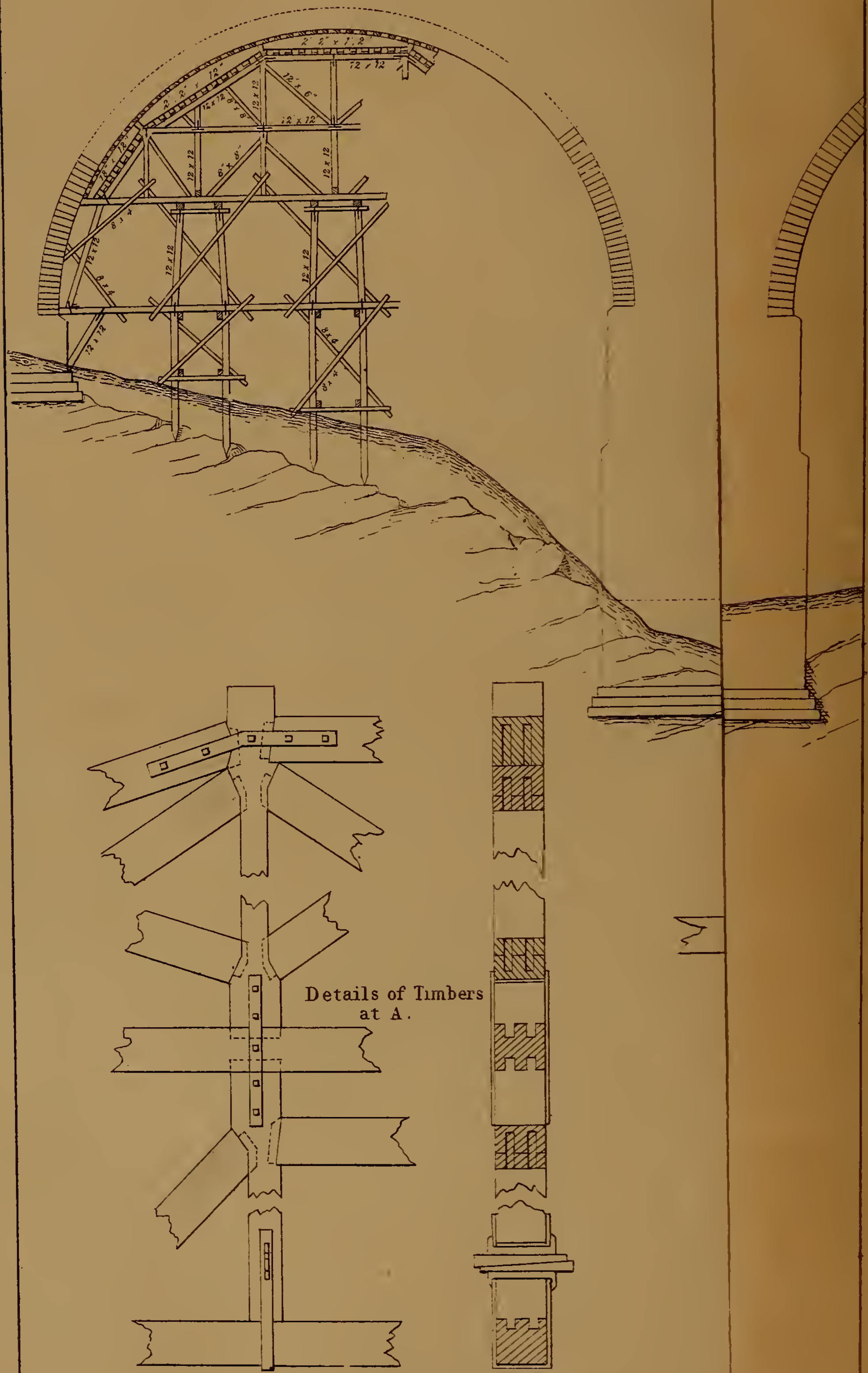


Fig. 3.

J. F. Jobbins lith.



Details of Timbers at A.

cks & Warwick

THE ARTIZAN.

No. XI.—NOVEMBER 30th, 1843.

Art. I.—HARBOURS OF REFUGE BETWEEN PORTSMOUTH AND THE THAMES.

This subject has been engaging the attention of Government for several years, during which time innumerable projects have been brought forward for harbours of refuge in every bay, and at every promontory all round the coast from Selsea Bill to the North Foreland. The different sites which have been pointed out and advocated by particular interests are not more numerous than the various plans of construction which have been proposed. Some are for fixed, and others for floating, breakwaters; some are for breakwaters connected with the shore, and so constructed as nearly to enclose the proposed harbour; while others are for isolated breakwaters, to act as a screen for sheltering the place of refuge.

The only point in which all parties appear perfectly to agree, is this,—that two or more harbours of refuge are absolutely necessary on this part of the coast, in order to afford shelter to our mercantile navy in the Channel, and to enable our ships to navigate with safety, in the event of a war with France.

In the recent inquiry made by a very able Parliamentary Committee, into the subject of shipwrecks, some very valuable evidence was elicited as to the necessity for harbours of refuge on the south-east coast. We have the satisfaction of mentioning on this subject the opinion of no less an authority than the Duke of Wellington, who gave evidence before this Committee on shipwrecks. His Grace observes, that "there is now no security for vessels between Portsmouth and the Thames; and, although Dover Roads is a very secure place during a northerly or easterly wind, it is, on the contrary, a very dangerous place in a wind from the south-west." With respect to all the present harbours on the coast, as Margate, Ramsgate, Dover, Folkstone, Rye, and others, they are one and all quite inadequate for the great purpose of a general harbour of refuge. They are all of very small dimensions; few of them have more than six feet of water at their entrance at low water, and most of them are occasionally inaccessible, owing to the bars which are constantly being formed by the shingle on this coast. In his evidence before the Committee, the Duke of Wellington strongly insisted on the necessity of affording protection to merchant ships in the Channel in time of war. He observes, that the French coast enjoys, over the coast of this country, very superior advantages for observing what passes in the Channel. The French coast has a northern aspect; the sun is at their backs; so that they can see every thing quite clear: and it is possible, from the coast of France, to calculate to a moment at what period a vessel coming up Channel will arrive at particular points. They may, therefore, be in readiness to seize her at any point where she may happen to be unguarded and without convoy. It is easy to see that, under such circumstances, some efficient means of protection will be highly essential to the prosperity and even safety of our commerce. His Grace is of opinion that there ought to be at least two harbours of refuge between Portsmouth and the Downs; and he suggested Dungeness and Dover as eligible places for the formation of such harbours.

Proposals for a Harbour between Margate and the North Foreland.

Commencing at the mouth of the Thames, and proceeding along the south-east coast, the first places which claim attention, with reference to projects of this nature, are Margate, and the great promontory of the North Foreland, lying a few miles further to the east. This promontory may be looked upon as common to the North Sea and to the Downs; and if an extensive harbour of refuge were practicable in this situation, its advantages to the shipping interest would be very great.

The present harbour of Margate is, of course, quite useless as a harbour of refuge, the entrance being dry at low water of spring-tides. The late Mr. Rennie is said to have thought favourably of the situation of Margate for a harbour of refuge. He proposed the extension of piers upon the Nayland and Fulsam rocks, which are low flats of chalk; the former lying on the west, and the latter on the east of the present harbour: and his plan embraced the formation of an outer harbour enclosed by a solid breakwater, and of an inner basin provided with lock-gates for shutting in a head of water for the purpose of scouring the entrance at low water. A more recent design has been brought forward at the instance of the present Pier and Harbour Company, in which a more extensive harbour is contemplated than that proposed by Mr. Rennie. According to this design, the piers would be run out to such a length as to give a depth of sixteen feet at the entrance at low water; and the entrance, which would be between 300 and 400 feet wide, would be towards the north-east instead of towards the north-west, as in the present harbour. The cost of this work is estimated by the surveyor to the Company at 275,000*l.*; this sum, however, does not include the deepening of the harbour, which would probably be expensive, as the depth in the bay is at present very little, and the bottom consists of chalk. The commission of naval officers and engineers appointed to survey the harbours of the south-east coast in 1840, proposed a harbour, on a very extensive scale, between Margate and the North Foreland. On examining the map at this place, it will be seen that at Foreness Point there is a projection called Longnose Spit. The eastern pier of the proposed harbour was to be carried out from Longnose Spit, a length of 1000 yards, in a north-north-east direction. The north side of the harbour was to be formed by a breakwater 2000 yards in length, connected with the eastern pier. The western pier was to be run out from a point about 600 yards east of Margate church, and was to be about the same length as the western pier, leaving an entrance 600 feet wide at the north-west angle of the harbour. These works would enclose an area of 460 acres; of which 108 acres near the shore would be under two fathoms in depth at low water, and the remaining 352 acres would vary in depth from two to six fathoms.

To decide on the comparative eligibility of the three designs which have been mentioned for a harbour near the North Foreland, would require a more minute and accurate local knowledge than we possess. There can be no question, however, about the immense importance of the situation, and the advantages of its prominent position with reference to the Downs and the North Sea. The exact position of the harbour—that is, whether it should be resolved into an enlargement of the present harbour of Margate—whether it should be formed of limited size, with an artificial sluicing power, as proposed by Mr. Rennie—or whether it should be carried further to the east, and thrown into deeper water, as contemplated in the more extensive project of the Harbour Commission already referred to, are matters of detail which can only be decided after the fullest investigation of the soundings, the stratification, the degree of shelter, and other important matters which are subjects for future inquiry. All this, however, is independent of the general policy of a harbour in this situation. Considered in this general point of view, we are of opinion that the situation of the North Foreland is one of the best fitted for a harbour that can be found, supposing it were actually determined that more than two should be constructed between Portsmouth and the Thames. For outward-bound vessels intending to proceed westward through the Channel, it would afford that great security which they stand so much in need of in south and south-westerly winds, and which they at present obtain so imperfectly by anchoring in the Downs. If the intentions of the Government be unfortunately limited to the formation of only one grand harbour of refuge on this part of the coast, it will be seen that there are other situations of more consequence, in connexion with the whole line of coast, than the North Foreland, which, of course, does not occupy by any means a central position between Portsmouth and the Thames.

Proposals for Harbours at Ramsgate and Sandwich.

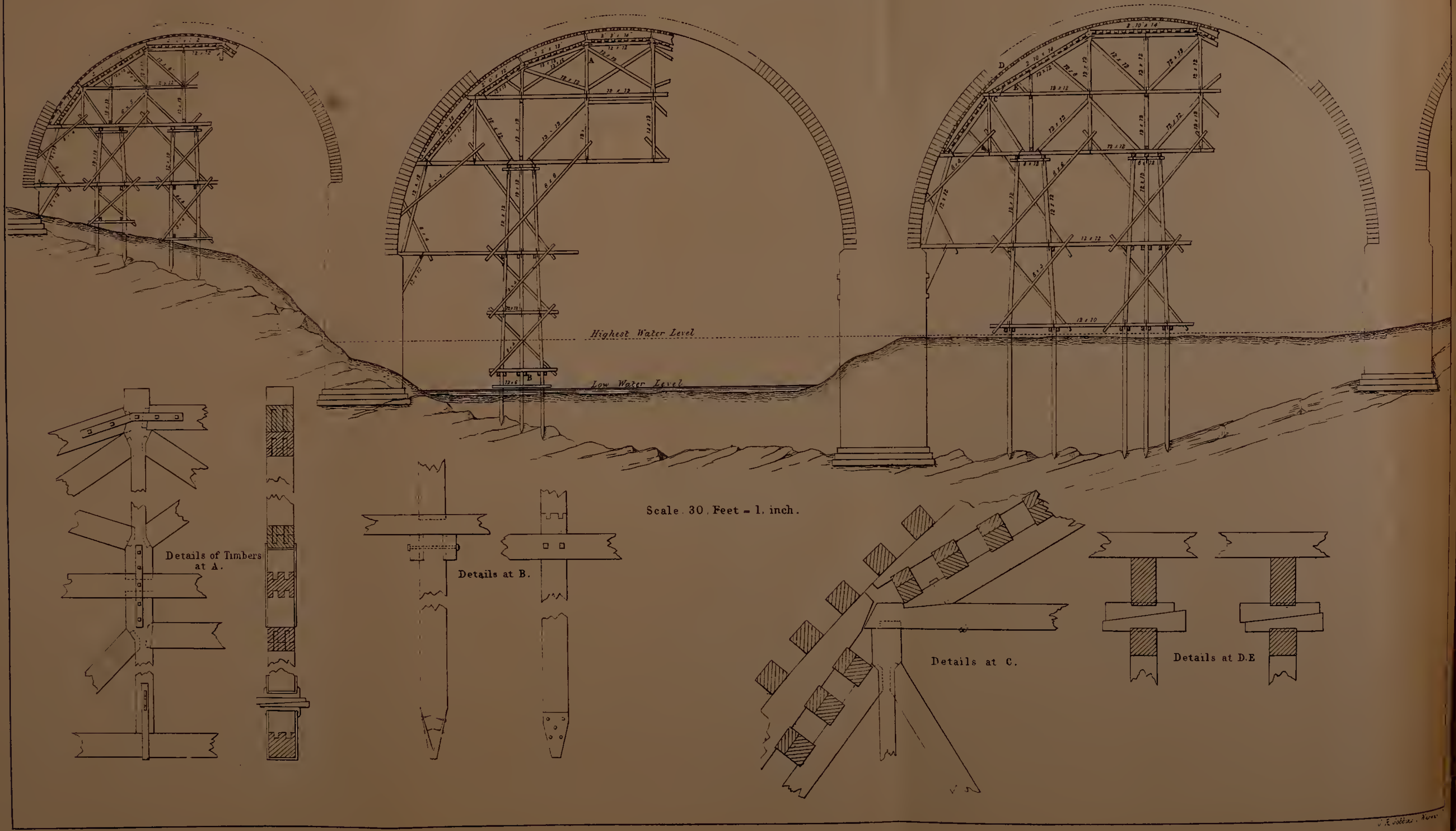
It has long been a favourite opinion of some nautical men, and of some eminent engineers, that, in consequence of the partial breakwater formed by the great natural bank of the Goodwin Sands, a harbour of refuge might be formed, at comparatively small expense, on some part of this coast. A project was accordingly brought forward many years since for a harbour in front of the flats between Sandwich and Deal; the principal inhabitants of these places taking great interest in the scheme, in consequence of the proposal to connect it by docks with the borough of Sandwich; in which case the river Stour would be available as back-water for scouring. The principal objection to this scheme is the great expense of obtaining sufficient depth in the first instance, and afterwards of preserving such a depth as to make the entrance practicable at all times of tide.

The late Mr. Rennie is said to have reported favourably of a harbour between the Break Sand and Sandwich Flats, an extensive and well-enclosed area of about 1850 acres, upwards of 24 feet in depth at low-water. Sir John Rennie is of opinion that a harbour might be made here capable of holding 400 sail of shipping, and with sufficient depth of water to contain ships of war, at an expense of about 1,250,000*l.* to 1,300,000*l.*

We come now to Mr. Bush's proposal for a harbour of refuge of 2260

DURHAM JUNCTION VIADUCT ACROSS THE WEAR.

Mode of Centreing for the Principal Arches.



acres, to be formed by embanking round the Goodwin Sands, so as to enclose, on two sides, the opening through the sands called Trinity Bay. Mr. Bush proposes to construct the embankment for this work upon the sands by means of caissons similar to that which he attempted to sink for a lighthouse in the course of last year. The expense of this work, as estimated by Mr. Bush himself, would be 600,000*l.* per mile for the embankment alone; and as this is eleven miles in length, the cost would be 6,600,000*l.* Mr. Bush is of opinion that the great quantity of valuable property to be regained from the numerous vessels wrecked on the sands during the last eight hundred years would pay the expense of this enormous undertaking.

Even setting aside the question of expense, the objections to this project are very serious. The swashway, or entrance, on the east side of Trinity Bay, has now only 8 feet in depth at low-water; and within the site of the proposed harbour, an immense extent of deepening would be required. The peculiar position and formation of these sands, situate as they are between the estuary of the Thames and the Straits of Dover, and originally formed and kept in existence by the deposit of alluvial matter where the tide of the North Sea meets that of the Channel, appear to indicate most clearly the utter unfitness and inexpediency of attempting to form a great harbour at Trinity Bay. Sir John Rennie and Mr. Cubitt perfectly agree upon the extreme risk of opposing a solid breakwater, in this situation, against the roll of shingle and the shifting of the sand which is constantly taking place. One of these engineers (Mr. Cubitt) observes, that the effect of stopping the drift over the sands would be to throw up a ridge of sand right in the entrance of the harbour; and insists that, however complete such a harbour might be made, the water would still go on, and throw up sand at the mouth of it. Sir John Rennie, although he does not venture to predict effects so positively as Mr. Cubitt, expresses his entire disapproval of the plan, in consequence of the difficulty and uncertainty of dealing with so treacherous a material as this quicksand is known to be. The naval officers examined before the Committee on Shipwrecks are not a bit more in favour of the plan than the engineers; so that Mr. Bush appears to stand alone in support of this scheme, which really seems so impracticable in every point of view, that we shall dismiss it without further comment. The objections to embanking the Goodwin Sands apply in some degree, although not to the same extent, against Sir John Rennie's proposal for a harbour at the Break Sand. This latter work, however, is altogether upon a smaller scale; the length and height of embankment would be much less, and the currents and shifting sands more manageable. Making a general comparison, however, between any project for a harbour on a favourable part of the coast, and one to be formed by embanking either on the Break or the Goodwin Sands, we cannot avoid expressing a decided preference for a deep-water harbour, either screened by a breakwater, or enclosed by piers carried out from the shore. The projects for harbours amongst the dangerous shifting sands of this coast, will at best have to rest upon gigantic experiments, whose success is extremely doubtful. And even supposing a harbour, great or small, to be constructed, there will still be the difficulty of keeping open an approach to it—a labour in which some of the most powerful and incessant forces of nature will have to be combated, we fear with very little prospect of success.

HARBOUR OF REFUGE AT DOVER.

This is one of the three situations proposed for a harbour, on a grand scale, by the Commission already referred to; and Mr. Cubitt, one of the Commissioners, on being examined before the recent Committee on Shipwrecks, very ably explained the advantages of the situation, and pointed out the method in which he proposed to accomplish the work. This method is remarkable alike for the judgment and ingenuity which it displays, and certainly reflects great credit on the able engineer who has devised it. He proposes to enclose about 400 acres of Dover Bay by means of two isolated breakwaters, one of which is to be 3000 feet long in a straight line; the other to be also 3000 feet long in one direction, with a return kant at the east end of 600 feet. At the east end of the harbour, also, a pier 700 feet long is to be run out so as to leave an opening of 1200 feet at this end. The western opening between the shore and the long breakwater is to be 600 feet, and the central opening between the two long breakwaters 700 feet.

This plan is somewhat different from that appended to the report of the Harbour Commissioners; in which latter the east and west openings were at the angles of the harbour, and not adjoining the shore, as in Mr. Cubitt's present plan. We think this last a decided improvement, as it gives a free passage to the flood-tide, and will allow the shingle to pass through without injury to that part of the harbour where vessels will lie at anchor.

Mr. Cubitt proposes a scheme for carrying this plan into execution, by means of which the Bay of Dover may be completely screened, so as to serve all the purposes of a harbour of refuge, in about three years from the commencement of the works, at an outlay of about 500,000*l.* He also shows how the breakwater thus rapidly constructed may be converted into a permanent work; which he proposes to effect in ten or fifteen years, at an annual outlay of from 50,000*l.* to 100,000*l.*; the harbour, all the time after the first three years, being in full occupation. "The method by which I propose to effect this," says Mr. Cubitt, "is by building caissons of timber of a triangular form, and from 100 to 300 feet in length each, well planked and caulked on the inside, loaded with sand and shingle, so as to float at a proper depth, towed out into the situation of the intended breakwater, and then sunk in line end to end, and filled up with sand and shingle to the top."

The caissons in this situation would require to be about 60 feet in height; and supposing them each 300 feet long, about twenty-two in number would form the two long breakwaters, with the kant at the eastern end. Mr. Cubitt observes, that breakwaters of this kind would be of great strength, and, in fact, would constitute all that was necessary, were it not that the timber would soon decay, and require renewal. In consequence of this, he proposes to give permanence to the work in a way which will render it almost imperishable, by carrying out slopes of rubble from the caissons both inside and outside the harbour. The following extract from a report made by Mr. Cubitt in 1841, will explain this more clearly:—

> "I consider the loaded caissons which form the harbour in the first instance, to be the nucleus or back-bone, as it were, of the proposed ultimate breakwater, which would be formed and completed by depositing rubble-stone, or the hard stone chalk, on both sides the caissons up to low-water mark in the first instance; that on the main or harbour side to a slope of two horizontal to one perpendicular; and that on the outer or sea side to a slope of four horizontal to one perpendicular. When the rubble wall is brought up to this height, viz., above low-water, and well filled in solid with sand, shingle, &c., so as to form a solid mass, the caissons may then be considered safe from the worm, and perfectly secure in their situation; after which the stone and chalk work should be continued at the same slope up to the required height, say 10 feet above high-water, of any required width for roadways, &c., and be surmounted with a parapet, and capable of being furnished with lights, signals, batteries, and every other means for use or defence that may be deemed necessary for the convenience and protection of a large and important harbour."

The site proposed by Mr. Cubitt for this great work is that immediately in front of Dover itself. The western breakwater commences about 200 yards east of Archcliffe Fort, and about half way between this place and the entrance of the present harbour. The eastern pier of the harbour opposite the return-kant of the eastern breakwater, is to run out from a point 630 yards east of the Castle jetty. It might be urged against Mr. Cubitt's plan of leaving an opening for the shingle at the north and south ends, so that it may pass quite across the bay as before, that this will occasion the same constant accumulation of shingle as that which now takes place at the mouth of the present harbour. This may be the case to a certain extent; but then it must be remembered, that when the harbour of refuge is constructed, very few vessels will require to use the old harbour—at least very few which cannot pass over the bar at high-water; the harbour of refuge affording them complete protection at all times until the entrance to the old harbour is practicable.

There are several other proposals for constructing harbours at Dover, which it appears scarcely necessary to notice at length. They differ from Mr. Cubitt's, not in the site proposed, but in the mode of construction and the form of the area to be inclosed by the breakwater. Mr. Steward's plan embraces the construction of a harbour at Dover, by curved breakwaters connected with the land, and leaving an opening in the middle, the area of the harbour to be about 500 acres, and the site the same as proposed by Mr. Cubitt. Mr. Wild proposes to form a breakwater with iron caissons, loaded with concrete; but this is a general plan, applicable to other places as well as Dover, and he has no plan of a harbour particularly adapted for Dover. The same may be said of Captain Grove's, Captain Taylor's, and the other floating breakwater works, which do not come under our consideration at present; because whatever may be thought of their capacity to form a harbour of refuge, the question still remains as to the most eligible site for forming one or more such harbours on the south-east coast.

It must be confessed, by any one who will look for a moment at the position of Dover with respect to the channel and the French coast, that it possesses many recommendations for a grand harbour of refuge. Conceiving Portland-roads, if enclosed and fortified, as the place best adapted to neutralize the formidable French position of Cherbourg, it seems that Dover is equally well fitted to oppose warlike attacks from Calais, to which it lies immediately opposite, in the narrowest part of the channel.

For these reasons, we are decidedly of opinion, if Government should resolve upon forming harbours at two or more places between Portsmouth and the Thames, the bay of Dover should at least be one of those places.

FOLKSTONE.

This is the next place on the coast which claims attention, not because it has been considered suitable, as far as we are aware, for a grand harbour of refuge, but because some extensive works are now in progress, with the view of considerably increasing the capability of the present harbour. These works are under the direction of Mr. Cubitt, who is constructing about 1200 feet of breakwater. The South-Eastern Railway Company have lately purchased this harbour from the Exchequer Loan Commissioners, and they have undertaken its improvement with the view of employing it as a shipping place in connection with their railway. Mr. Cubitt's works at Folkstone harbour, it should be observed, have no connection with the floating breakwater in course of trial there by Captain Sleigh. This latter is a mere experiment, similar to that which was made in the beginning of the present year with Captain Grove's breakwater at Dover. It will be remembered, that this trial of Captain Grove's breakwater was at first unsuccessful, as it broke away from its moorings, and came ashore in January last; but we understand that the length of 80 feet, which had been originally laid down by Captain Groves, has since been replaced by the Admiralty, and has stood well up to this time. It is further understood, that the Admiralty is willing to make a trial of Captain Grove's breakwater on a more extensive scale, and has proposed to lay down 21 sections, each 50 feet in length, at a cost of 7,500*l.*; but at present the Treasury does not think proper to advance the money. These sections consist each of an air-tight iron cylinder, six feet diameter, properly moored, and a circuit of these sections constitutes the harbour. Captain Sleigh proposes to construct his floating breakwater in lengths of 85 feet. Each section is something like the hull of a ship, and has an inclined platform laid across it, and supported by stays in such a way as to present the inclined surface to the impact of the waves. The width of the caisson, or hull of each section, is 14 feet, and its depth six feet. The breadth of the artificial beach, which is the name given by Captain Sleigh to the inclined platform, is 60 feet. The inventor states the cost of this breakwater to be 12*l.* per lineal foot. Two lengths, of 85 feet each, are either now laid down, or about to be laid down, for the purpose of trial at Folkstone.

Considered with respect to depth of water, anchorage, and facility for constructing a harbour of refuge, Folkstone does not possess such great natural advantages as Dover, while it entirely wants those artificial accompaniments of a great harbour—such as docks, warehouses, and fortifications—all of which are possessed by Dover.

DUNGENESS.

This famous promontory is the next point of the coast which attracts attention. It forms the south-eastern extremity of the great diluvial tract of low country, called Romney Marsh, and occupies nearly a central position between Dover and Beachy Head. Dungeness has been proposed by several experienced naval officers, as a place extremely well suited by its position for the rendezvous of armed vessels in time of war; and it is said that the establishment of a harbour and graving-docks at this place would have saved great expense and inconvenience in the late war, when vessels, even of the smallest description, were obliged to run from this part of the channel up to Sheerness, for the purpose of trifling repairs, and even for the payment of their men. Captain Peat, R. N., who was examined before the Select Committee on Shipwrecks, and who is said to have a perfect knowledge of this part of the coast, is of opinion, if only one harbour of refuge is to be made, that Dungeness has many advantages over Dover. His idea is, that a breakwater of about a mile in length, would afford complete protection to vessels lying in East Bay, a little to the east of the projecting point of Dungeness. The anchorage at Dungeness is said to be good, and the depth of water off the point about six fathoms.

The well known light of Dungeness is said to be often confounded by merchant vessels in the Channel with that of Gris Nez, on the opposite coast of France. Dungeness is one of the places mentioned by the Duke of Wellington in connection with Dover, as being eligible for a harbour of refuge; but his Grace afterwards said, in explanation, that he had only mentioned Dungeness from a general impression that, as it afforded a natural security on one side or the other, according to the wind, it might be practicable with greater facility to make a harbour there than at any other point.

There are, however, engineering objections to a harbour at Dungeness, which, in spite of the advantages presented by its commanding and central situation, seem too formidable to justify the recommendations which have been advanced in its favour. The promontory of Dungeness is yearly increasing and projecting further into the sea, on account of the great accumulations of shingle which are taking place; and very reasonable doubts may be entertained as to the practicability of keeping up the required depth of water in the harbour. The quantity of shingle at Dungeness is very much greater than that which passes Dover; and the accumulations at the former place are also much more formidable—a fact abundantly proved by the yearly growth of land in front of the light-house and the martello-towers. Looking at Dungeness merely with reference to the selection of a harbour of refuge for ships in distress running up Channel, it certainly appears to be very inferior to Dover, or to a harbour in the Downs; because vessels which have once weathered the promontory of Beachy Head, can generally run on with ease past Dungeness; and the same wind will carry them right on to the Downs, or at least as far as Dover. Again, with respect to the situation for a naval depôt and station for a steam flotilla, it is evident that if Dover should be fixed on for the grand harbour, the arrangements for repair and equipment of armed vessels might be made there with greater facility than at a place where all the necessary docks and other works would have to be constructed for the special purposes of a naval dock-yard. For these reasons, we think that it would be inexpedient to incur the vast expense of a solid breakwater harbour at Dungeness; but we recommend it as well adapted for the trial of one or more of the proposed floating breakwater projects, because breakwaters on the floating principle can be shifted out of the way of shingle banks, and therefore possess, in a situation like this, great advantages over the solid form, always supposing that the floating sections can be securely moored.

RYE.

The ancient harbour of Rye, situated at the embouchure of the river Rother, was formerly of some importance, but is now entirely useless as a place of refuge, owing to the vast accumulations of mud and shingle, which choke up the crooked and uncertain entrance. The place is by no means adapted for a harbour on the extensive scale required on this coast, because the depth of water is far too inconsiderable, and vessels would drive on a lee-shore in attempting to enter a harbour in this situation. In connection with the state of the present harbour of Rye, there are some striking remarks in the Report of the Harbour Commissioners, on the bad effect of stopping the flow of the tide up the channels of such rivers as the Rother; but as they do not bear on the subject of the present inquiry, we must hasten to notice the other possible sites for harbours on this coast.

BEACHY HEAD.

We come next to a part of the coast which has been generally recognized as one of considerable danger, and where, in consequence, a harbour of refuge would be highly desirable. In consequence of the great projection of Beachy Head, it happens that many vessels are lost to the west of this point, when coming up Channel even with a fair wind. The opinion seems to be very general among the best authorities, that there ought to be a harbour of refuge somewhere in the neighbourhood of Beachy Head; but considerable difference of opinion exists as to whether the harbour should be on the east or west side of the promontory. The Harbour Commissioners recommend the bight on the east side, and Mr. Cubitt, in his recent evidence, professes the same opinion. The estimated cost of one mile and a half of breakwater, capable of sheltering an area of 450 acres, at this place, is stated in the Commissioners' Report to be about 2,000,000*l.* sterling. It was proposed to build the breakwater in a curved form, detached from the shore, and about one mile distant from it, a position which would shelter an area half a mile in width with a depth in no part less than two fathoms at low water. We are sorry to be obliged to differ from the Harbour Commissioners with respect to the proper site for this Harbour at Beachy Head, and we do so with the more diffidence, because the recommendations and opinions propounded by them appear generally to be dictated by practical wisdom, founded on a well-conducted inquiry and comprehensive knowledge of the subject. Looking, however, to the proposed harbour at Beachy Head as a place of refuge intended for trading vessels in distress, we are at a loss to discover of what use to such vessels can a harbour be on the east of the promontory, with the well-known fact staring us in the face, that not only are numerous vessels wrecked on the west side when trying to weather the point with the wind blowing ashore, but that they even get embayed and come on shore when running up Channel with a fair wind. The principal part at which vessels have come on shore near Beachy Head, is on the west side between Cuckmare Haven and Berling Gap. Indeed the whole coast, from Brighton to Beachy Head, has proved very fatal to vessels; and we are therefore clearly of opinion, that the great harbour for their protection in unfavourable weather, should at least be on the west side of the promontory. Putting aside for a moment the question of security in time of war, and of a station for armed steam vessels—and considering merely the comparative advantages of a harbour suited for the mercantile navy, we are of opinion that the neighbourhood of Beachy possesses advantages over Dover itself; and this very exclusive applicability of the place for the accommodation of the merchant service, is only another reason for so placing the harbour as to afford the necessary security where shipwrecks occur. This condition will, in our opinion, be most completely fulfilled by fixing the site of the harbour a little west of the promontory at Beachy Head.

NEWHAVEN.

This place has been favourably thought of for the security of vessels getting embayed on this part of the coast, and being unable to weather Beachy Head. The present harbour is of very contracted dimensions, but is said to be capable of certain improvements, which are now under consideration, by which this and other objections would be mitigated. The place does not appear to be well adapted for a great national work, as it lies so much in a bay that vessels leaving it during the prevailing winds would encounter a great risk of running on shore before doubling Beachy Head. One thing appears clear, that somewhere between Newhaven and Beachy Head ought to be formed the third great harbour of refuge between the Thames and the Isle of Wight, but the determination of the exact site will be better effected after more minute surveys of this part of the coast than we yet possess.

BRIGHTON.

This is the last place which we propose to notice in connection with the present inquiry. Brighton lies in the centre or deepest part of the great bay, stretching between Beachy Head and the Isle of Wight. A great deal of shingle travels along this coast, which has no protection from the prevailing winds. We have seen no nautical survey of this part of the coast possessing sufficient accuracy to found a judgment upon. There is a plan by a Mr. Wild for making a harbour here by means of fixed iron caissons, to be filled with concrete; and this plan, with some modifications, might possibly answer, or at any rate it is worth considering. It is impossible to estimate the expense of a harbour at this place without proper soundings, and other data which have not been brought forward.

As regards the eligibility of Brighton for a harbour of refuge, we conceive the place has both advantages and disadvantages, the former not sufficiently powerful to weigh in its favour against the other sites more to the east; but inasmuch as the situation of Brighton is central between Beachy Head and the anchorages within the Isle of Wight, an investigation appears to be called for into the practicability of forming a harbour somewhere in this neighbourhood. Should Government decide on a fourth harbour between the Thames and the Isle of Wight, Brighton will stand a fair chance of being selected; but except in this case, we think that other places will have the preference. Brighton would be an excellent place for the trial of floating breakwaters, which would prove of great service to the numerous small boats which use the pier, and which are often much distressed in stormy weather. We understand that Captain Taylor is in course of negotiation to lay down some sections of his breakwater at this place, and we shall look forward with interest to the result of the experiment.

Our opinion of the various points on the coast most suitable for the establishment of harbours of refuge has been so fully expressed in the course of the preceding remarks, that it will only be necessary to recapitulate very briefly the conclusions we have arrived at. Should Government, looking to the commercial importance of security from shipwreck in the Channel, and to the paramount necessity of extensive protection from warlike attacks in the event of hostilities with France, come to the determination of establishing three great harbours of refuge between the Thames and the Isle of Wight, the places which we consider most eligible, ranked in the order of preference, are:—

1. Dover.
2. Some point between Beachy Head and Cuckmare Haven.
3. Foreness Point, between Margate and the North Foreland.

We shall receive with serious regret the announcement that any one of these important stations is to be omitted. The Chancellor of the Exchequer having, however, stated that 6,000,000*l.* would be required for the establishment of three such harbours as those required, it can scarcely be expected, that in the present state of our finances the whole number of these harbours, involving as they do gigantic engineering works, can be undertaken simultaneously. If one only then is to be undertaken, let Dover have the preference, say we, as it forms the key as it were to the English Channel; and is equally well adapted, by its position, for the defence of the Channel and of the Downs, in time of war. The claims of the mercantile marine require, in the next place, that if a second harbour be undertaken, it should be placed in the neighbourhood of Beachy Head, which has been the scene of so many fatal disasters in the way of shipwrecks.

With these remarks, we consign this important subject to those who are able to give it more effectual support than we can pretend to do. We recommend it to the serious consideration of Government, as one possessing great national importance, involving the prosperity of the whole mercantile navy, and affecting, in a greater or less degree, every interest in this great country. And when it is remembered that 600 ships, 1,500 lives, and between two and three millions of property are annually lost to this country by shipwreck, it will hardly be alleged against us, that we are exaggerating the importance of the measures we recommend, or are lending undue prominency to this inquiry. These facts must be our apology for the length to which this article has extended: it was impossible for us to dismiss a subject so momentous without comment, or to pass it slightly over; and although the more fastidious part of our readers will no doubt condemn our prolixity, we shall console ourselves with the approbation of those who can pardon the appropriation of a great space to a great subject.

ART. II.—WOODEN RAILWAYS.

IN our notice of the Atmospheric Railway, in the last Number of the ARTIZAN, we stated our conviction that that system of railway conveyance would prove more economical in its working than the locomotive system, though we questioned whether the original cost of construction would be less than that of a single line of railway on the ordinary plan. We have now to consider a proposition of an opposite kind, in which the cost of original construction would be much less, whilst the probable expense of the traffic would be greater.

It has long since been proposed, as a means of obtaining the advantages of railways without their enormous cost, to lay down wooden rails, or trams, on common roads, or on lines of their own along the face of the country, without more cuttings or embankments than are required in common road-making. The greater adhesion of the wood to the tires of the wheels would, it was presumed, enable them to obtain sufficient "purchase" on the rails to prevent the wheels from slipping on ascending the inclines. One of the chief difficulties of such a plan, however, was to keep the engine on the rails, for it was found that if the wheels had flanches, they quickly cut up and wore away the wood against which they were continually rubbing, as the engine swerved from side to side, and particularly in curves of the road. If, to avoid this inconvenience, the wheels were made flat, and the rails were wider and laid level with the road, the dirt and gravel collected on them would soon form a hindrance to the motion. To overcome these objections to the use of wooden railways, a contrivance has been recently introduced by Mr. Prosser, which, so far as we can judge from the experiments hitherto made, appears to answer perfectly the ends for which it is intended, and also to serve as additional means of safety in case of the fracture of an axle. The chief part of the invention consists in having two additional axles fixed under the engine, for the purpose of bearing guide-wheels, to retain the engine on the rails. The axles are bent on each side, at angles of forty-five degrees, and on the circumferences of the guide-wheels are deep rectangular grooves, so as to fit on to the square on the top of the rails, when those wheels are brought into action. The guide-wheels, thus placed obliquely, do not rest upon nor touch the rails when the engine is moving directly on the line, but whenever there is the least swerving on either side the grooved circumferences of those wheels bear on the inner parts of the wooden rails, and correct, in the same manner as a flange, the tendency to run off the rail. The guide-wheels, indeed, act as rotary flanges, and serve to keep the engines and carriages on the rails, without the friction which flanges on the wheels must always occasion. These additional wheels, independently of acting as guides, serve also the important purpose of safety-wheels; for, should the axle of the bearing wheels break, the weight of the engine or carriage will rest on the oblique wheels, which will carry it along safely to the next station.

If we assume, as we think we may, that the invention of Mr. Prosser has overcome the difficulty which presented itself to the use of wooden rails, we have next to consider the advantages and disadvantages likely to result from substituting wood for iron.

In a short experimental line of wooden railway which has been laid down near Vauxhall Bridge, it has been endeavoured to test, as far as could be done under the circumstances, the probable wear of such railways, and the capability of the locomotives to ascend steep inclines. The engine, which was originally constructed for common roads, has been running backwards and forwards on the line daily for the last six months, and it has passed over it a number of times equivalent to four years' traffic on a railway over which twelve trains pass daily. The wood is only Scotch fir, prepared by Payne's process, yet it exhibits few indications of wear, and even the saw-marks are not worn out. It is only on the curve, which is one of small radius, that any marks of the grooves of the guide-wheels are perceptible. It is true that the engine is a comparatively light one, and the wear occasioned by the loaded trains is not included; yet, notwithstanding these imperfections of the trial, the wood is so little worn by the experiments to which it has been subjected, as to prove the practicability of its employment as a substitute for iron. The experiments to try the capability of ascending hills have been perfectly successful. In the short experimental line there are gradients at each end, one of which is an ascent of 1 in 22; the other is as steep as 1 in 10. Up the former the engine was moved without any slipping of the wheels, even where there was only one driving-wheel in gear; up the steeper incline, the wheels, on the day we witnessed the experiment, frequently slipped, in consequence of the rails being in a very greasy state, but the engine was nevertheless raised to the top of the short steep hill. When it is borne in mind that the steepest part of the incline between the Camden Town depôt and Euston-square terminus, on the London and Birmingham Railway, is only 1 in 66, and that the celebrated Bromsgrove Lickey incline, between Birmingham and Gloucester, is 1 in 37, the lesser of the inclines on the wooden rails—1 in 22—will be deemed quite if not more than sufficient for all practical purposes.

Allowing, therefore, that wood is sufficiently durable for railways, and that, with adequate power, an engine and train may be propelled up inclines as steep as those generally met with on common roads, it must be evident that an undulating railroad of this kind might be constructed at comparatively little cost. The engineering works and the cost of the land, which are estimated by Mr. R. Stephenson to be usually about half the expense, would be insignificant, and the cost of laying the wooden rails and of ballasting, would be much below that of ordinary iron railways. The average cost of such a railway, with its establishment of engines and carriages, might therefore be safely estimated at one-half that of the cheaper lines of railway in England; and if we assume, with Mr. R. Stephenson, in his report on French railways, that an iron railway may be constructed and placed in working order for 26,000*l.* per mile, where no extraordinary engineering difficulties present themselves, we may calculate that a wooden railway would in few circumstances cost upwards of 13,000*l.* per mile.

We put out of consideration, for the present, the practicability of forming tramways on common roads, which might of course be done at much less expense, for we fear that if the speed were not reduced much below what is now considered "railway speed," the velocity and consequent noise of a locomotive engine and train would render the same road impracticable for horses, until the animals were gradually broken in to stand such strange sights and sounds. It must not be forgotten, however, as one of the advantages of wooden railways, that the noise would be greatly diminished, and in this respect wooden rails would be as great an improvement upon iron as wooden pavement is upon stone.

It may be asked, however, is there no set-off against all these important advantages? Is iron to be driven from the road without admitting that it possesses any quality superior to wood? Not so, exactly. One of the qualities, indeed, which is claimed for wood, as giving it great advantage over iron, is gained only by a disadvantage which, for the general purposes of locomotion, forms rather a serious drawback to its utility. For example, the greater hold which the wheels have on wooden rails is procured by the additional friction, or, more correctly speaking, by the additional resistance, of the surfaces. So far as regards the driving-wheels this additional resistance is an advantage, as they act thus more steadily, and are much less likely to slip. It is different, however, as regards the wheels of the carriages that are drawn along by the engine; for in their case the less resistance they encounter, the more effectually is the power employed in drawing the load, and the greater the load it can consequently draw. The resistance offered by the surface of the rails is distinct from that of friction, for the surfaces of the rails and the tires of the wheels do not rub against each other; the obstruction to motion arises from the inequalities of the rails, over the small projections of which the load has to be lifted. Where wood is used instead of iron, the softer nature of the material causes it to yield, in a minute degree, to the pressure, and it thus occasions a depression in the part whereon the wheels rest. The load has, therefore, to be always lifted from a slight hollow formed by the yielding of the fibres of the wood, and the effect is the same as if the carriages were drawn on a rigid rail up an incline equal to that constantly formed by the wood as the wheels advance. The amount of this obstruction must necessarily vary with the quality of the wood and with the load; and we believe it will be found to increase more rapidly than the ratio of the weight. Much, no doubt, may be done to harden the surface, and we understand that wood prepared by Payne's process becomes so much indurated as greatly to diminish the resistance from this cause. But it is evident that, however prepared, it cannot be so rigid as iron, and to the extent of the difference between them must be the greater obstruction to motion offered by wood. Nor is the advantage of the additional hold on the rails so great as might be supposed, for it is not on account of the difficulty of working a locomotive engine up inclines that hills are avoided, but principally because the power required to lift a heavy train up hill is so much greater than is necessary to propel it on a level. Those who have witnessed the efforts of locomotive engines to draw a train of ballast-wagons up the incline at Camden Town, must be convinced that if steep inclines were adopted with locomotive engines, it would be requisite either to diminish the load or to employ more power. In ascending the incline at Camden Town with a locomotive, the inconvenience does not arise from the slipping of the driving-wheels, but from the weight of the load to be lifted, and this resistance would have always to be encountered on ascending the inclines of wooden railways, with the additional obstruction to motion arising from the yielding of the wood.

It appears, therefore, from the foregoing consideration of the advantages and disadvantages of wooden railways, that whilst they may be constructed at half the cost of iron railroads, they would require much more locomotive power to propel trains of an equal weight to those in common use; or, what is equivalent, the same locomotive power would only propel a smaller number of carriages. First-class gradients and iron rails must, therefore, always be superior, theoretically, to undulating railways and wood; but the question is, whether those advantages are worth their additional cost. On lines of great traffic they may be so, but on all lines of inferior traffic it appears that the object of public convenience may be best attained by less costly railways, and by smaller and more frequent trains. The locomotive power may be more expensive, but, compared with the difference in the original outlay on railways of iron and of wood, the difference would be insignificant. For most of the lines yet to be completed it this country, and for all the proposed lines of railway in Ireland, the plan of wooden railways seems well adapted, and the form of carriage invented by Mr. Prosser, to overcome the difficulties of steam locomotion on wood, promises to effect its purpose completely, with the addition of greater safety.

Art. III.—THE PHENOMENA OF SPRINGS.

There has been much mystification at various times respecting the sources whence springs derive their supplies of fresh water. It is contended by some, that the water which is found in deep wells, below the level of the sea, is the produce of the infiltration of the water of the ocean, which, it is supposed, loses its saline particles by percolating through the sand and other mineral substances. To account for the springs of water often found issuing forth at the tops of high mountains, it has been maintained that the water with which the ground is saturated far beneath the surface, is evaporated by the central heat of the earth, and that the vapour rising up through caverns and fissures in the mountains is condensed at the top, and contributes to supply those elevated springs which, from their position, it is supposed, cannot arise from the drainage of surrounding rocks. In the articles on Artesian Wells, and on the Water Supply of London, in former numbers of the Artizan, we endeavoured to show that the vast reservoirs of water contained in the subjacent strata are collections from the drainage of the surface, and that the quantity of rain which falls annually is amply sufficient to supply the ever-flowing rivers, and all the springs, without rendering it necessary to have recourse to the filtration of the sea to account for the abundance of fresh water. Taking the annual average fall of rain in this country at twenty-four inches, the drainage of 100 square miles, or half the area of the smallest county in England, would be sufficient for the annual water consumption of the inhabitants of England and Wales. If, therefore, there requires no extraordinary cause, beyond the drainage of the surface, to account for the quantity of fresh water, the only difficulties that remain to be solved are, to explain the continually flowing springs of fresh water in situations where, apparently, there is no drainage, and the causes of intermittent and of tidal springs, which rise and fall with the ebb and flow of the tide.

The mystery attending the existence of springs on the tops of mountains was solved very satisfactorily by M. Arago, by examining the actual situation of those springs which had been cited as the most anomalous instances. It was found that in every case there was a considerable area of rock above the level of the springs, though, to a casual observer, the flowing water might appear to issue from the highest points. The pond on the top of Hampstead Heath may be mentioned as an apt illustration of the apparent mystery and its elucidation. That pond is, to a casual observer, at the highest part of the hill, and there is no higher ground for many miles around, yet the pond is seldom dried up, even in the hottest summers. On examining the situation attentively, however, it will be found that the level of the water is below that of a considerable portion of the surrounding land, from the drainage of which it might derive its supply.

The phenomenon of intermittent springs, which rise and fall at intervals, has been well explained by the supposition that the fissures of the rocks, which draw off the water, are formed like a syphon, so that when the water rises to a certain height it begins to flow through the fissure, and continues to do so until its level is below that of the connecting aperture. The water then rises again, until the syphon is once more brought into action.

The tidal springs appear at first view to countenance the supposition that the salt water becomes fresh by filtration, but a consideration of the real cause of their action will show that opinion to be without any foundation. A tidal well, in which the water rises and falls with the flow and the ebb of the tide, must, it is true, be connected with the sea; but that affords no more evidence that the salt water is turned into fresh, than the rise and fall of the tide at London Bridge proves that the fresh water of the Thames must be derived from the filtration of the salt water of the sea. There have been persons indeed who have so imagined, and who have projected plans for converting salt water into fresh by filtering it through sand, founding their projects on the assumed change of salt water into fresh in tidal rivers. Such projects, however, will scarcely meet with countenance at the present day, for it is well known that from all rivers there is a continual flow of fresh water into the sea, and though the rising of the tide throws back the water towards its source for the time, the flow of water is always greater than the reflux of the tide. A similar effect takes place in tidal wells. The water which supplies the wells flows from them into the sea. When the tide comes in, the flow of fresh water is kept back by the higher level of the water, and the wells consequently become fuller; when the tide ebbs, the water flows along the communicating channel as the level of the sea subsides, and the water in the wells sinks accordingly. In these cases there is no mingling of the salt water with the fresh, because the channels of communication are continually full; therefore the salt water can have no access to the well.

It is a very common occurrence to find springs of fresh water rising through the sands on the sea-shore, and travellers, when in search of water, usually go to the shore, if within reach of it, in the confident expectation of discovering a spring underneath the sands. From this fact many intelligent travellers have concluded that the water thus found is the water of the sea deprived of its saline particles by filtration through the sand. This circumstance, however, admits of easy explanation, without any such supposition. The sea-shore is the lowest level, and to that the drainage of the land is conveyed, when the nature of the soil permits the water to percolate through it.

There is, in fact, no foundation for assuming that the saline particles held in solution in sea-water can be expelled by mechanical means. The salt is chemically combined with the liquid, and it is as impossible to extract it by mere filtration as it would be to deprive a mixture of vinegar and water of its acidity by the same process. The opinion that springs of fresh water derived their supply directly from the sea, without undergoing the previous processes of evaporation and condensation in the form of rain, was for a long time supported by fallacious calculations of the quantities of water that flow from rivers into the sea. In a geographical work, which was edited by Sir I. Newton, and was in use at Cambridge University at the end of the seventeenth century, it was stated that each one of the rivers of the first order, in different parts of the globe, pours out into the sea annually a quantity of water that exceeds in magnitude the size of the earth! It was further estimated that so great was the quantity of water carried by the Volga to the Caspian Sea, that it was ***absolutely necessary*** there should be an incessant flow of the sea back into the earth. Figures, it is sometimes said, can never err, but these extravagant calculations afford one instance among many that figures are the most dangerous guides that can be followed in the search of truth, unless their faithfulness has been well approved and their correctness tested by established facts. The estimates thus given to the world in the seventeenth century, with the sanction of Newton, were far more calculated to mislead respecting the sources of springs than the opinions of Aristotle and the ancient philosophers, who conceived that the supply of water was derived from the condensation of the air contained within the caverns of the earth. More recent calculations of the quantity of water discharged by rivers prove that the water they carry to the sea is not equal to the quantity of rain that falls in the valleys through which they flow.

There is another problem connected with the absorption of rain by the earth more difficult to solve. Where does the water go? Hundreds of yards below the level of the sea currents of water are found rushing into chasms of unknown depth, which are never filled. This question, and the consideration whence the hot water of thermal springs proceeds, belong to the speculations of geology, with which we will not now interfere, our present object being limited to the explanation of the phenomena of the springs and rivers which derive their sources from rain, and which flow by the gravitation of their waters down the valleys to the ocean. To that vast reservoir to which they return they owe their origin, though not immediately, as was formerly supposed, by the reflux of the water opposed to the laws of gravitation, but after having been evaporated and subsequently condensed in the form of clouds and rain.

Art. IV.—ON THE HEALTH OF THE WORKING CLASSES IN LARGE TOWNS.

No. 4.

The observations made in some of our preceding Numbers, and the distressing details into which we have felt it a paramount duty to enter, abundantly prove the necessity of speedy and effective measures for diminishing the surplus loss of life and strength caused by inattention to, or destitution of, personal and domestic comforts; and we only trust that the importance attached to this subject by ourselves may be felt also by our readers, many of whom are personally interested in the investigation. There can be no doubt, indeed, that disease and debility are incurred to a great extent through ignorance and imprudence:—the mode of remedying and averting them, therefore, must be found in knowledge,—for we are fully sure that if the mass of the people—a people pre-eminent in the possession of sterling *common sense*—be once instructed in the delicate nature and acute sensibilities of their own frame, and made clearly to understand that disease is not an accident, but has fixed causes, many of which can be averted, causing the removal, also, of a vast deal of suffering, want, and intellectual depression:—nay, let the mass of the community be only properly enlightened on these points, which deeply affect their welfare—even their very existence; and there can be no doubt that they will apply their knowledge not only to the improvement of their private habits and family arrangements, but to that philanthropic agitation and active interest which may hasten the enactment of general municipal laws favouring the public health. Impressed with this conviction, we propose, by way of concluding the subject, to show both the *private* and *public* remedies for the fearful evils in our large towns—evils easily removable—evils, too, that cause an annual loss of life in London, Manchester, and Liverpool, alone, equal to that caused by the havoc of war in any modern campaign, and make the survivors improvident, reckless, and depraved—at once miserable in themselves and dangerous to their neighbours.

First, of the *private* remedies, those which each man can apply for himself without interference from law or town authorities:—and we may observe here, that one grand initiatory step in the business is, to awaken whole families from the lazy indifference to cleanliness, decency, and a sweet, wholesome atmosphere, which sits like an incubus on the households of plodding, laborious artizans. On this point we have the evidence of a clergyman, (the chaplain of the Bath union,) in a letter to the Poor-law Commissioners;—and what clergyman is there in any of our large manufacturing towns who could not cite dozens of cases equally striking? "Let a man remain even for a short time in a close, pent-up room, sickening from the smell, and the perception of closeness will so entirely vanish, that he will almost fancy that the atmosphere has been purified since his entrance: if, then, such are the effects of an hour in blunting our refined sensations, and rendering them insensible to noxious exhalations, what must be the influence of years on the coarser perceptions of the working man? All who know the lower classes will testify, that the last want felt by the dirty is cleanliness; and that their last expenditure is on the comforts of their home. Two winters ago I found a painter, whose bed was without blankets, whose room was almost without furniture, who was destitute even of the ordinary utensils of civilized life, whose floor was covered with worse filth than that of the streets:—I found this man at dinner with a roast leg of pork stuffed with onions, a Yorkshire pudding, a large jug of ale, cheese and a salad. Indeed, I will undertake to say that half the gentlemen in Bath did not sit down on that day to so good a dinner."—(*Letter from the Rev. W. Elwin*, quoted in the *General Sanitary Report*, p. 136.) This picture is, we should hope, the representation of an extreme case; but there can be no doubt, that both the workpeople and their *wives*—no unimportant personages at home—are very generally all but indifferent to cleanliness and comfort, even when wages admit of luxuries as well as mere comforts:—nay, we have now before us several cases in which, while the family earnings amount to 35*s.* or 40*s.* a-week, (and the families neither large nor helpless,) their houses are the very picture of disorder and want. To substitute a provident, frugal expenditure for thoughtless, wanton extravagance in the brutish pleasures of the stomach, is quite in the power of the working man; and if the surplus thus saved were expended in the means and appliances for increased decency and comfort, life would unquestionably be prolonged to the workman, his home would be a palace instead of a dungeon, and his family would grow up around him useful and respectable, instead of being consigned, at his premature death, to the mercies of an union-workhouse. True, he might be compelled to pay an increased rent for his increased house-comforts; but he has the means wherewithal to satisfy his creditors, and is able, by a prudent economy, to make an appearance equal to that of persons moving in a much higher sphere. We love this ambition, for it is the moving spring which has called into action our Arkwrights, our Horrockses, our Taylors, our Cowpers, and almost all our practical men who, by dint of persevering, untiring energy, aided by rare talent, have raised themselves from the station of humble workmen to that of moneyed, master-manufacturers and thorough scholars in practical science. We love the ambition, also, because it is the initiative sentiment of a higher state of being,—a state, in which man soars above the physical into the moral existence, begins to realise the independence of mind from mere matter, and looks even beyond the present state into one of future and unalloyed happiness. The extravagance and bad economy of families in the working classes are so notorious, that it would be impossible to question them. Huckster-dealing, almost universal among the working classes, is a most spendthrift mode of living, which, without enriching the paltry retailer, most effectually robs the poor man of nearly a quarter of his weekly earnings:—and when we add the intemperance induced by the low state of physical feeling incidental to persons ill lodged and ill fed, we point out the chief means by which the evils of surplus disease and premature death may be averted. We know, indeed,—and the objection is sure to be urged against us,—that absolute want and destitution, from the total absence of employment, are the constant and fertile causes of mortality; but whence does that destitution arise? From misconduct, in a hundred instances for one that springs from sheer misfortune. But how many instances—thousands, alas! of instances are there, in which people live in dirt, discomfort, and an atmosphere of disease, while at the same time they possess (if they would but employ) the means of avoiding such fearful, sickening, depopulating influences. They will not employ them, however; and they deride all the warnings of their best and most honest friends. What is the consequence? Typhus is almost constantly hovering over, and often an inmate of, the dwellings of such people:—nay, we are well assured that throughout the country the attacks of disease are chiefly upon those in full employment, and that the attack of fever precedes the destitution, not the destitution the disease. Contagious diseases generally meet with a constant nursery in crowded mephitic tenements; and childhood lingers too often in a puny state of inanition, too often is wholly extinguished, ere it rises into manhood. Let the artizans of Britain fly at once, and at all hazards, from the fatally depressing influences that sap their own vital energies, make their homes comfortless and unhappy, and deprive their children of that first gift of nature, health, without which every other blessing is a mere blank. To stay in an atmosphere of disease, when health is so easily attainable, is an act of suicidal madness. Owners of houses may not choose to reform—may prefer enormous profits—often amounting to 300 per cent. on the value; but the renters of houses and lodgings have their own remedy; and we are well assured that, knowing the dangers by which they are at present surrounded, they will seek a remedy in flight to some more favoured region.

Secondly, we must consider the *public* remedies by which these evils are to be reformed. And here we may remark, that the older tenements in most of our towns—those in which the working classes chiefly reside—were the creations of necessity, formed without any plan, and almost without reference to the health, convenience, and respectability of the parties intended to be their inmates. House after house, and cottage after cottage, are built according to the wants of the moment; drainage, sewerage, and water supplies are wholly forgotten or uncared for; and the consequences, sad indeed, are recorded too faithfully in the burial registers. To put a stop to such crying evils, that cannot be too frequently exposed, too emphatically denounced, some legislative enactments are absolutely necessary. We have reasons for stating that some such enactments will soon be taken up as Government measures; but, let us observe, half measures in this matter will be of no avail; for if there be not some general, well-expressed, decisive act passed, the Legislature might as well not interfere at all. The interests of the poor, the industrious, the deserving, are at stake; and private interests must not warp the measures of Committees, even in St. Stephen's.* Let us detail a few only of the measures which we think desirable in this process of reform.

In most of our great towns, in the first place, but more especially in London, which comprises almost a million of artizans, there is a great want of unity and real efficiency in the corporate bodies who perform the duty of cleansing, lighting, and supplying them with water. The boards of management too frequently consist of persons both incompetent and irresponsible,—persons whose situation exposes them to the baneful influence of petty, local interests, and who have not the most distant acquaintance with the recondite mysteries of building or civil engineering. The exposures in the Metropolitan Sewers' Committee (Sess. 5 & 6. Will. IV.) are quite sufficient to prove that the important business of *cleaning* a million and a half of people,—for such is, in fact, the duty of the Sewers' Commissioners—is most wretchedly, even disgracefully performed, and that too at about treble the price which it might cost under properly united and effective arrangements. The whole business, moreover, should surely be put in charge of competent inspectors; and who can do it better than well-educated *civil engineers*—men, who understand the power of materials, levelling, hydraulics, and all matters concerned in the formation of primary town-arrangements? But, what is of almost equal importance, the inspectors must be so appointed as to have no interest in understating or exaggerating the evils of which they are witnesses. As it is at present, a tailor, or a grocer, or a cabinet-maker, takes a fancy to a high parochial position, or else a man of decayed fortune but good interest seeks to improve his income by an almost sinecure employment; and thus the interests—the vital interests of the millions—are basely sacrificed to those of the few. In the next place—and it is mentioned here, because it belongs to the same subject—the rates for all such purposes should be levied, *not on the occupant, but the proprietor;* the occupant is a poor and often an ignorant man, who would evade any expense, the necessity of which was not thoroughly apparent to himself; whereas the proprietor has a more lasting interest, and has the means of repaying himself by throwing the surplus expenditure—a mere trifle—into the general rental. Thus the poor occupant would be unconsciously put in possession of constant comforts now unknown to him, the Commissioners would be benefited by the diminution of distress-warrants and bad debts, while the proprietor himself would be no loser. Thirdly, there is an absolute necessity for some general building act—one that applies not to this or that town, but to the towns of the empire generally—an act that would be retrospective as well as prospective—an Act that should comprise provisions for obviating the evils of closeness, mal-arrangement, and want of sewerage—an act that should give stringent powers for carrying into full effect, in spite of all petty local interests, the sanitary regulations necessary to a great town. At the same time, it would be highly important to include some provisions for an ample, even profuse, supply of water, (that best of detergent fluids,) to the habitations of all without reserve, and that too at a far lower rate than that levied by any of our metropolitan companies.

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* We allude here to the Buildings' Regulation Committee of the House of Commons in 1842. The evidence was most certainly given by interested parties, and the statements therein made are absolutely astounding to any person at all experienced in the state of the humbler tenements in Liverpool, Manchester, Oldham, and Stockport.

Let it be remembered, however, that the public health is affected in other ways than by the mal-arrangements of families content to live in mire and misery. Every large town has *lodging-houses*—low places of resort for the migratory or mendicant poor—abodes redolent with a mixture of tobacco-smoke, strong onions, rank herrings, and foul linen; hostelries in which the lock and key are the landlord's chief protection, whither thief, swindler, cheat, and prostitute, herd together in reckless, devilish, intimacy: over these places the law has now no control; and yet we have strong medical evidence (confirming long, practical experience) to prove, that typhus, small-pox, consumption, and many other morbific influences, are powerfully at work, killing off people in the prime of life, and sending down to posterity a starveling, dissipated, short-lived race, heirs to scrofula, consumption, and rheumatism. These evils we desire to remove; and, as such places of humble lodgment must and ought to exist, we would suggest the absolute necessity of police regulations, and very stringent too, in order that they may be safe, both for the money-getting proprietor and his unfortunate lodgers. More cases of fever occur in these lodging-houses than any other dwellings; and what wonder, where fifteen, twenty, nay thirty people of both sexes herd like swine, indifferent alike to decency, cleanliness, or good morals, in a single room? Such evils as these cry for reform, and *must* be reformed. The poor victims, who have no other refuge, cannot command reform; but the contagion spreads—the typhus, the cholera, the scarlatina runs from one street into another—from the garret or the cellar of destitution and crime, to the bedroom and the nursery of the rich—to the households of the respectable tradesman and the hard-working artizan. All, therefore, are interested, and all have a right to claim this kind of reform. A word or two on the workshops of England:—some, indeed, those especially of the much-maligned factory-people in Lancashire, Cheshire, and Yorkshire, are admirably warmed and ventilated; but there are many,—very many, kept even by men who net their thousands in this metropolis, so small for the persons employed, and so horribly close—so thoroughly destitute of the means for admitting the vital gases—that surely some measures for improvement are absolutely and speedily required. If all the above regulations are carried into effect, we cannot doubt that the yearly mortality will be greatly lessened; for we have traced the causes, know their fatal effect, and implicitly believe in the virtue of our remedial suggestions.

The observations here made have issued out of a thorough, practical acquaintance with the sufferings of the industrious classes; and we feel sure that there exist in those very classes a good, practical sense that will appreciate our efforts. Good and influential men are now at work in probing the wounds of our fellow-countrymen, in order that a proper remedy may be applied; but let us hope that the time will soon arrive, when men shall be employed rather in *preventing* than in *curing* maladies, when governments shall be induced, as their prime interest, to consider a nation's health—an object quite as important as the promotion of its commerce or the maintenance of its conquests. Then, and then only, may we hope to see the approach of those times when, after having lived many years of cheerful usefulness, we may close the term of an unharassed existence by a peaceful transmission into a still happier world.

Art. V.—A PROBLEM FOR THE INGENIOUS.

We have for some time past been endeavouring to design an indicator, which would be suitable for steam vessels, with the view of ascertaining the quantity of work done by their engines in a given time. A common counter would probably be sufficient for this purpose, were it not that the expansive plan of working the steam is now widely prevalent in steam vessels, and the degree of expansion is not uniform, but varies with the resistances the vessel experiences. An indicator, therefore, to be a true one, must take note of these variations, and register them at their true value; and without some such instrument it is impossible to carry into effect the plan of registration in steam vessels, which we have so often recommended.

It will be obvious, from what we have said, that the instrument we desire to see invented, must so far differ from a common indicator as to register, as well as to observe, the fluctuating pressure within the cylinder at every part of the stroke. There are some instruments already in existence which pretend to do this, the best known of which is Moseley's constant indicator; but that instrument is very complicated; and as some of the parts are driven by friction surfaces, which are liable to slip, there is considerable uncertainty in its action. An indicator of this description will not come into use unless it be simple, exact, and of easy application; and one so distinguished would be of much value.

It appears to us to be necessary to the accomplishment of the end in view, that there should be a combination of two movements—the one constant, derived from the engine or from a clock; and the other variable, derived from the piston of the indicator. Out of this combination the true result is certainly to be derived, but no good method of deriving it has hitherto occurred to us. We therefore hand over the knotty point to those of our readers who have more time, as well as more ingenuity, than we can muster; and shall be happy to publish any solution which appears worthy of that distinction.

Art. VI.—ST. ETIENNE AND ITS MANUFACTURES: WITH SHORT NOTICES OF THE INDUSTRY OF PITTSBURGH AND OF COVENTRY.

If foreign travel have the effect of expanding the minds of those sufficiently favoured by fortune to be able to indulge therein, scarcely less will an acquaintance with foreign countries, reaped from the perusal of good authorities, tend to improve those who are precluded by circumstances from the advantages to be gained by observing men and manners abroad. Indeed, with the spread of international communication, it has become a matter of necessity, that the engineer, for example, who pretends to be even tolerably well-informed, should be cognizant of the various canals and railways already completed or in progress in various parts of the civilized world;—that the merchant should make himself acquainted with the civil polity, with the national spirit, and with the physical peculiarities which obtain in different states, so that he may the more accurately calculate what effect foreign events may have on the markets with which he has to do; and that the medical man, who desires to keep himself abreast of the growing intelligence of the age, should continually direct his attention to the important discoveries in medical science, now rapidly progressing on the continent of Europe. Nor is it less necessary that the artizan of Great Britain should become acquainted with the state and relative importance of his art, and the condition of those who pursue it in foreign countries. Imbued with this idea, we shall bring under notice the industry of St. Etienne, a town of France, and the principal seat of the iron manufacture in that country. In so doing, it will not be expected that we shall attempt to institute any close comparison between the trade of St. Etienne and that of Birmingham, of which a sketch has recently been given in the Artizan (p. 231); for although the former town has been pompously styled the "Birmingham of France," it is in every respect greatly in the rear of its English prototype. The difference between the two towns will be obvious at once. Birmingham, according to the last census, in 1841, numbered 138,215 inhabitants; while St. Etienne, in 1836, had no more than 41,534, and at the present time its population is probably much below 50,000. Again, the industry in the former place is for the most part confined to the manufacture of metallic goods; whereas, in St. Etienne, it is at least equally, if not more, bent towards the production of woven fabrics. In fact, Liege, in the low countries, and Pittsburgh in America, are much more deserving of comparison with Birmingham than is St. Etienne. But it is most natural, whenever we look abroad for an object to compare with what we have at home, that our ideas should be first directed towards France, as the most powerful and wealthy of all continental nations, and the only one which (at any rate for a long lapse of ages to come) may fairly be expected to rival Great Britain in wealth, power, or commercial enterprise. We may here, however, stop to remark—and the comparison we are about to institute is a case in proof of the point—that we need, neither for the present nor the future, fear any competition of the French in the manufacture of the goods which may be considered as our staples of trade. We need never look forward with any apprehension to a time at which French iron, steel, cotton, or woollen goods will supersede our own in the general markets of the world. French manufacturing industry is, it is true, in nowise insignificant abstractedly; but, as compared with that of the nations surrounding France from the north round to the east, it sinks into marvellous inferiority. In truth, the French are not a manufacturing people; and hence the inferiority of St. Etienne to Birmingham, Rouen to Manchester, and Elbeuf to Leeds or Halifax, as places of industry, though each and every of these French towns would be in themselves better situated locally as centres of extensive trade, by their position in Europe, and natural means of communication with foreign countries, than their English congeners, were their *population*—that which gives life and character to every spot on the globe—equally disposed to commercial and manufacturing enterprize with our own.

St. Etienne is a town in the South of France, the capital of an *arrondissement** in the department of the Loire, and situated on the banks of a tributary of that river, a little more than thirty miles (in a straight line) south-west of Lyons, which, as all our readers well know, is the chief manufacturing town in the southern part of the French dominions, and, next to Paris, the chief centre of population in France. The proximity of a rich and populous town like Lyons, with which it is connected by a railway, has, no doubt, contributed somewhat to the rise and prosperity of St. Etienne: but the chief reason of these effects has been, that St. Etienne stands in the centre of a productive coal district—owing, therefore, its consequence to the same cause that has produced the high prosperity of most of the manufacturing towns of Great Britain. Without this valuable mineral, the highest advantages of other kinds must have been of comparatively little avail: without it, England herself must, ere this, have sunk to the level of a second-rate nation.

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* An *arrondissement* is the division of a French department, similar to the rapes in Sussex, the lathes in Kent, or the wards in some of the northern counties, Durham, for example. It is an extent of country usually much larger than the hundreds common to most of the English counties. A department in France is commonly about equal in extent to two average-sized counties in England; each department being seldom divided into more than four arrondissements.

St. Etienne had, as above stated, in 1836, a population of about 42,000. It is mostly well-built. One of its churches is said to date as far back as the sixth century; but it has few other antiquities or public edifices worthy of notice. Arms and weapons of war are articles which compose a large proportion of the goods made at St. Etienne, the water of the rivulet on which it stands being reputed particularly well adapted for the process of tempering steel. It is said, though on no certain authority, that arms were manufactured here before the Christian era, at which time the town, anciently called *Furanum*, was the station of a Roman legion of veterans. It can only be stated with correctness, that at the earliest period of which any records exist of St. Etienne, it was a mere hamlet, inhabited by workers in iron. In 1535, during the reign of Francis I., a royal manufactory of arms was established here, at which muskets, pistols, carbines, and all similar kinds of weapons were made. It was during the continued wars of Louis XIV. that the greatest impulse was given to this branch of industry, and the prosperity of St. Etienne augmented considerably at that epoch. In 1795 and 1796, 100,000 muskets yearly were manufactured for the Directory; and under Napoleon, in 1811, as many as 150,000 were made. According to M. Hedde, the fire-arms made there for the French Government in 1831, amounted to about 105,000; but at present, in ordinary years, from 25,000 to 30,000 muskets (or no more than one-nineteenth of the number made yearly at Birmingham) are manufactured to Government order, at about 30*s.* each, and 5,000 for exportation, at somewhat less than 1*l.* each. About 25,000 fowling-pieces and 2,000 pairs of pocket-pistols are made yearly: the average price of the former, two-thirds of which are double-barrelled and percussion guns, is about 50 francs, or 2*l.* 2*s.* each. In all, about 7,000 hands are occupied in the gun manufacture.

The industry of the department of the Loire is mostly concentrated in the arrondissement of St. Etienne; and M. Hedde estimates the annual value of the goods produced in this district at somewhat more than 73,000,000 francs, or 2,920,000*l.* We think this estimate, however, is considerably above the mark. Of this amount, also, the coal raised is estimated as worth 7,000,000 francs; the raw metal cast at 8,000,000 francs; the cutlery and hardware at 4,800,000 francs (192,000*l.*); nails, 5,000,000 francs; fire-arms, 2,300,000 francs (92,000*l.*), yearly; ribbons and other silk goods, about 38,700,000 francs (1,550,000*l.*); and lace, cotton thread, and other manufactured products, including glass, paper, leather, lamp-black, &c., stand for nearly 3,000,000 francs. But it must be borne in mind that all this industry is not that of St. Etienne itself, but is spread over a district about as large as Warwickshire, comprising also St. Chamond, and other small manufacturing towns. If goods to the value of one-third, or, at the very utmost, one-half the above amount are produced yearly in St. Etienne and its neighbourhood, it is as much as can be accorded it with any probability.

From what has been thus stated, it will be abundantly obvious that Birmingham or Sheffield need fear no competition from so insignificant a rival as St. Etienne, and, indeed, the places are hardly to be ranked in the same category. Far more likely is the comparison of St. Etienne with Pittsburgh, in the United States. Pittsburgh, which has been styled the "Birmingham of America," is a town of Pennsylvania, on the Alleghany, where it joins another river to form the Ohio, 264 miles (direct distance), west by north, from Philadelphia. In 1840 the town proper had 21,296 inhabitants; but if we include its suburbs, Alleghany, Birmingham, &c., the total population at that period could not have been less than 50,000, and is now, doubtless, much larger. It is admirably placed for both manufactures and trade, having not only a copious supply of water for its machinery, &c., but an all but unlimited command of inland navigation, connected as it is with New Orleans and all the important towns in the south-western and western states by the Ohio, Mississippi, and their tributaries, and by canals and railroads with the great lakes (Erie, Ontario, &c.), as well as with Philadelphia and the cities on the Atlantic. According to the American Almanack the value of the cast-iron goods annually made at Pittsburgh was, in 1840, estimated at 446,800 dollars (about 95,000*l.*); of bar-iron goods at 4,500,000 dol. (956,000*l.*); and of hardware and cutlery at 351,000 dol. (74,700*l.*) Most of the machinery used for the steam navigation on the western rivers is produced here; and, in addition, larger quantities of nails, fire-grates, chain cables, tools, fire-arms, &c., are made at Pittsburgh than in any other part of the Union. Yet still—and it is an undeniable proof of the greater excellence of our own manufactures, and of the solidity of our pre-eminence in the working of metals—all the finer kinds of hardware and cutlery, and a large proportion of the other metallic products required for consumption in the United States, continue to be imported from England.

Turn we now from the consideration of the hardware manufactures, to that of the loom-products of St. Etienne. M. Villerene remarks, "The traveller who visits St. Etienne is surprised to witness silk ribbon and lace factories located in the midst of a region where the atmosphere is polluted by a dense cloud of coal smoke from furnaces and iron forges. It must instantly strike every one, that manufactures of such delicacy can hardly be too far removed from such agencies—from the birth-place of the spade, pick-axe, anvil, sword, and bayonet. The two branches of industry would seem to be wholly incompatible."—(*Tableau des Ouvriers.*) Their union certainly is incongruous enough; but, as long back as the tenth or eleventh century, this incongruity is said to have existed. Within a few years, however, the silk ribbon makers have, for the most part, left the town, to establish themselves in the suburbs and surrounding country. The inhabitants of St. Etienne and the adjacent district, interested in its manufacturing industry, have been estimated at 60,000; and of these about half are supposed to be connected with the silk trade. In 1835, the ribbons woven daily in the district were estimated to average altogether 350,000 ells, being about 130,000,000 of yards annually, of an aggregate value of perhaps 32,000,000 francs (1,280,000*l.*) Of this quantity three-fourths are said to be sent out of France. Between fifty and sixty artists were, at the above date, employed in drawing patterns for the manufacturers. The wages at St. Etienne are somewhat less than at Lyons. A man may gain from 1*s.* to 3*s.* 8*d.* per day, the average being about 1*s.* 8*d.* This is rather less than at Coventry, where weavers ordinarily get from 12*s.* to 30*s.* a week, and throwsters (chiefly children) from 2*s.* 6*d.* to 7*s.*; while silk-winding yields from 6*s.* to 8*s.*, shute-filling from 3*s.* to 8*s.*, and warping from 7*s.* to 9*s.*, weekly, these occupations being mostly performed by females.—(*Hand-loom Weavers' Report.*) But it would be fallacious to institute any relative comparison of the prosperity of the work people of Coventry and St. Etienne grounded on the difference in the amount of their wages, for the weavers in the district around the latter town are mostly little farmers, who divide their time between the labours of the loom and of agriculture, and have thus a double resource for a livelihood. Some, indeed, and these are principally lace-makers, devote their labour wholly to weaving, working in the shops of masters who possess from two to five, or sometimes ten or twelve looms. On the whole, however, we are inclined to think, that such weavers as can live out of the town of St. Etienne, so as to avoid the *octroi* duties, or duties upon all articles of provision entering within the walls, are better off than the weavers of Coventry, while those are, perhaps, as a mass, worse off who are compelled by circumstances to reside within the municipal limits.

Art. VII.—IRON ROOFING.

Corrugated cast-iron plates are now employed to a considerable extent in Scotland for roofing. These plates are something similar to the wrought-iron corrugated plates used for the covered part of the Blackwall Railway.

The peculiarity of the cast-iron plates is, that they form a complete arch, without the support of stays, ties, or skeleton frame-work. Short pins only are required to connect the flanges of the adjacent pieces; so that the whole erection of a roof of this description is nearly as simple a matter as stitching the slates upon a common roof, centering being only required for the first tier.

The nature of the corrugations will be best described by saying that the longitudinal section of the roof resembles a series of consecutive W's, the vertical angles being about 100°, and the length of side five inches.

The size of the plates is 50 inches × 26 inches; weight about 72 lbs.; the adjacent ends are made to abut and overlap, while the edges merely overlap.

So far as experience has yet gone, an iron structure of this kind, even though unprotected by zincking or other chemical appliance, appears to be of almost indefinite durability.*

Another iron roof, of a very different description, has been partially introduced in Glasgow, composed of very light cast-iron tiles, suitable either for an elliptic or peaked roof, supported by cast-iron longitudinal ridges, upon wrought couples or hurdles. The tiles are 18 inches long × 6 inches broad, one-twelfth of an inch in thickness, cast with one gate; weight about $2\frac{3}{4}$ lbs. This form of roof is, we believe, the registered invention of Messrs. Neil and Crawfurd, and is at present manufactured by Messrs. Aitken and Allan, Kelvin Foundry, Glasgow. Did the cheapness of this roof equal its elegance and lightness, it might be used extensively. At present we fear its cost may be an obstacle to its introduction.

Art. VIII.—THE BUILDING ARTS.

OBLIQUE ARCHES.—No. II.

In our last article on this subject, we briefly described the most approved method of forming the working moulds, and applying them in practice. This method is chiefly derived from the well-known properties of the sections of the cylinder and its developements, and we believe it to suffice for the greater number of the cases which may be expected to arise. It may be satisfactory, however, if, in addition to what we have already advanced, we notice some of those less scientific expedients which accomplish their end, without aid from constructive geometry, by which means the time spent, and the difficulty encountered in the developement of the intradosial and extradosial surfaces of large arches, may in a great measure be obviated.

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* This kind of roof has been adopted to some extent at Coltness and Govan iron works, near Glasgow.

Fig. 1, plate xxxi., shows the dimensions of a segmental arch,—the span of the right section of the arch F L, is 8 feet. The versed sine D C, is 2 feet; the obliquity of the arch, 6 feet; the width of the bridge between the faces of the parapets, 12 feet; and the thickness of the ring stones, 2 feet. Having the foregoing dimensions, it will be seen, that from the property of the right angled triangle, and other well-known data, we may arrive at the whole of the other dimensions required by calculation only.

To find the radius of the cylinder.

The rule laid down in a former number of the Artizan, is as follows:—*Divide the sum of the squares of the half chord, and versed sine, by twice the versed sine, and the quotient is the radius.*

Here, then, we have A D, the half chord 4 feet, and the versed sine D C = 2 feet.

By the rule, $\frac{4^2 + 2^2}{\text{twice } 2} = \frac{16 + 4}{4} = \frac{20}{4} = 5$ feet the length of the radius.

To find the length of the face of the arch.

Let F L, (the length of the span of the arch) form the base of a right angled triangle, and G L (the obliquity of the arch) the perpendicular.

The rule for finding the hypothenuse is as follows:—*Add the squares of the base and perpendicular together, and the square root of their sum is the hypothenuse.*

Thus, $\sqrt{FL^2 + GL^2}$ or, $\sqrt{8^2 + 6^2} = \sqrt{64 + 36} = 10$, the hypothenuse or length of the face required.

To find the length of the springing line.

Let fall, or conceive the line G K to be the width between the outer faces of the parapet walls, we have then a right angled triangle G K I, of the same angles as those in the triangle F L G.

Then, by similar triangles, F L : F G : : G K : G I, or by figures; as, 8 : 10 : : 12 : 15ft. the length of the springing line required.

In order to obtain the exact position and dimensions of the spiral courses of the arch stones, it is necessary that the developement of the intradosial and extradosial surfaces of the arch must be laid down. The constructive mode of ascertaining the boundary lines of the covering of the cylinder will be seen by referring back to page 206, in our article on the covering of cylinders, and to which we would refer the student in laying down the curvilinear lines M P, and T U in fig. 3, for ascertaining the bevels for the quoin heads.

It may here be observed, that the straight line M O P in the developement, will, when applied on the surface of the cylinder, form the position of a spiral line; and the curvilinear line M P, when applied on the cylinder, will coincide with the plain surface of the face of the arch.

The width M N of this covering (see fig. 1.) will be equal to the length of the arc A C B, which may be obtained by the following rule. *From eight times the chord of the half arc, subtract the chord of the whole arc, and one-third of the remainder is the length of the arc* sufficiently near for all practical purposes. Here the student will observe, that the length of the half chord A C must first be obtained. The half chord being the hypothenuse of the right angled triangle A D C, then by the rule hereinbefore mentioned,

$$\sqrt{AD^2 + DC^2} = AC;$$

or, $\sqrt{4^2 + 2^2} = \sqrt{16 + 4} = \sqrt{20} = 4{\cdot}472$ feet, the length of the half chord A C.

then, $\frac{8 \times 4{\cdot}472 - 8}{3} = 9{\cdot}26$ feet, is the length of the arc A C B, which is also the width of the developement of the intradosial surface of the arch.

To find the width of the developement of the extradosial surface of the arch.

Having obtained the radius of the arc A C B, which is 5 feet, and the length of the arc A C B = 9·26 feet,—the given thickness of the ring of the arch = 2 feet, the radius of the outer arc will be 7 feet.

Then, by proportion, as E B : A C B : : E *o* : *p q o*
or, as 5 : 9·26 : : 7 : 12·96 feet the length of the outer arc *o p q*, or the width Y X of the developement of the extradosial surface of the archstones, as shown by fig. 3.

Having thus far premised, let us proceed to take into consideration the number of the courses of the arch stones, and accomodate their divisions to meet the extreme points of the springing lines P B and G I.

In the diagram, fig. 1., make M N equal to the length of the arc A C B, which has been found to be 9·26 feet: make S M = G I the length of the springing line, which is found to be 15 feet; draw the line M N at right angles to S M, and form the right angled triangle M P N, by making P N = to G L, the obliquity of the bridge. Having the base line M N = 9·26 feet, and the perpendicular line P N = 6 feet. Then,

$$\sqrt{PN^2 + MN^2} = MP$$

or, $\sqrt{6^2 + 9{\cdot}26^2} = \sqrt{36 + 85{\cdot}74} = \sqrt{121{\cdot}74} = 11{\cdot}03$ feet the length of the developed spiral line M P, which embraces the united portions of the arch stones on the intradosial surface in the direction of the heading joints of each alternate course; upon this line arc to be laid down the divisions for the arch stones, but previously to these divisions being made, the student will observe, that the lines of the coursing joints, (for instance that at S O,) are at right angles with M P; the point S being determined by the existing position of that point of the springing course; it therefore becomes necessary to ascertain the length of the line M O; the line S O being at right angles with M O, and the triangles S O M, and M P N being similar: by proportion we have,

M P : P N : : M S : M O

or, 11·03 : 6·0 : : 15· : 8·13 feet which is to be divided into the most convenient number of coursing stones necessary for the triangular portions of the soffits formed by the triangles S M O and R Q P. Assuming therefore, that this line M O, is divided into eight courses of 1·03 feet each, (taking care to make allowance for the mortar joints,) there yet remains that part of the line O P to be divided into courses. Now, having ascertained the length of the line M P to be 11·03 feet, and the line M O, 8·13 feet; their difference O P will be 2·9 feet, which may be divided into three courses of 0·966 feet, or $11\frac{5}{8}$ inches nearly.

The line M O being divided into eight courses, it then follows that the serrated springing courses must also be divided in the same number of equal parts. In order, therefore, to ascertain the length of each of the inclined surfaces of the serrated portions of the beds of the springer, we must first ascertain the length of the line S O, which may be obtained by similar triangles, for,

M P : M N : : M S : S O

or 11·03 : 9·26 : : 15· : 12·59 feet, which being divided by 8, the number of the inclined surfaces on the springer, gives 1·57 feet, which is the length of each bed of the springers. It will also be observed, by reference to the Fig. No. 3, that the lengths of the stretchers are twice that of the length of the beds of the springer stones; their length, therefore, will be 1·57 × 2 = 3·14 feet.

Having obtained the whole of the foregoing dimensions, which the student is enabled to do without reference to any accuracy of drawing, he must then proceed to lay down the principal lines of the developement of the inner and outer surfaces of the intrados and extrados, of the full size, as shown by Fig. 3, taking care to ascertain with accuracy the position of the lines S A· and V B·, which it will be seen intersect each other on the central line of the drawing in the point Z. Little more of the drawing is required than the division of the coursing lines, and the correct curvilinear lines for ascertaining the bevels of the quoin heads. The moulds for the coursing and heading joints are already described in our last article, Oblique Arches, No. 1.

The methods of finding the bevels of the quoin heads, and rules for the twist of the beds, are also similar in all respects to those therein described.

It may here be remarked, that in any case where the centre for the curvature of the coursing moulds is, from the great length of radius, found inaccessible, the circle may be drawn as shown by diagram Fig. 4; having ascertained any three points of the curve as described in our article No. 1, above alluded to, then fix the rods at such an angle that the edges of each may touch the three points in the curve as shown; and having braced the rods at the same angle, the curve may be formed by moving the angle C of the rods towards the points A and B, care to be taken to keep the edges of the rods close to the points of the curve, during its motion; the angle C forms the curve line in its progress.

The angle on each side of the rule D being equal to each other, the line of the heading joint will also, by its motion, be accurately laid down.

Art. IX.—REMARKS ON CUTTINGS, EMBANKMENTS, AND OTHER EARTHWORKS.

GENERAL OBSERVATIONS ON CLAY.

There are some very peculiar properties connected with clay. In its natural state, when dry, it is hard and firm, and can readily be reduced into powder. Mixed with water, its characters are entirely altered; it becomes soft, unctuous, and so plastic as to retain with fidelity any form into which it is moulded or fashioned. Nor does it require to be mechanically mixed with water in order to produce this change. It is sufficient that water shall be allowed to fall or flow upon it, when its state is the hardest and driest, and it will very quickly have the effect of softening and reducing it into an unctuous, plastic substance. Again; let this soft substance, well tempered, and worked up with water, be dried and baked, either under a very strong sun, or by the application of artificial heat, and it acquires a hardness which rivals that of the limestones and sandstones of nature. It is now incapable of being changed from this state of hardness into the plastic condition by the addition of water; and, if sufficiently baked, no chemical process whatever will restore the plasticity which it has now completely lost. The piece of clay, burnt or baked into a brick, a tile, or into any of those numerous vessels and utensils which are fabricated by the potter, may be reduced into a sand, or powder, which has properties entirely different from the powder of dry clay. The powder of pounded pottery is a substance of great energy in the fabrication of mortar, is capable of conferring hydraulic properties upon common lime mortar, and, mixed with common mortar, was used by the Romans as a cement for lining baths, cisterns, and reservoirs.

Many different opinions have been entertained as to the origin of clay. According to the hypothesis of Ludwig,[*] clay has been derived from calcareous substances, reduced into powder by the action of salt water; and the grains of this powder have been united by a glutinous cement. The objection to this is, that clays are not now found on the sea-shore, and that pure clay does not contain any calcareous ingredients.

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[*] Encyclopedie Methodique; Geographie Physique, art. Argile.

Mr. Boyle, and afterwards M. de Buffon, were of opinion that clay was derived from sand; their idea being, that sand was decomposed by the action of the air, and was then changed into clay. But, if this supposition be correct, how is it that the deserts of Africa, covered as they are with sand, present no traces of this change? Under this hypothesis, also, the occurrence of alternate beds of sand and clay is incapable of explanation. Some have supposed that argil, or clay, is a sediment from the sea; and others have attributed its origin to *humus*, which is the *débris* of plants and vegetables. Clay, however, contains no principle which can be identified with the composition either of vegetables or animals; and besides, there is a very wide difference between *humus* and clay.

The able author of the article "Argile," already referred to (note *), is of opinion that clay is a strictly primitive earth, and has not been derived from elemental action upon any of the earths which now exist contemporaneously with itself. He comes to this conclusion, first, because clay is almost universally diffused; second, because it has properties strictly peculiar to itself; and third, because its uses are so important that the globe could not exist as it does, without the general influence which is exercised by the presence of this substance.

All these notions, however, as to the origin of clay, have been exploded by the researches of modern chemistry. This substance is now generally admitted to be an oxide of the metal *aluminum;* which latter, when heated, possesses a great affinity for oxygen. If we suppose, however, that clay is really formed by the union of oxygen with this metal, we must conceive pure aluminum to have been, at one time, extensively diffused over the surface of the earth; and, if we might venture a supposition as to the circumstances of their union, it would be this; that, wherever water came in contact with the pure earth aluminum, the water was decomposed, and its oxygen united with the aluminum to form clay, while its hydrogen freely escaped. This would leave clay in that moist and plastic condition in which it is now always found; and it is probable that the subsequent action of water, and its transport by rivers from place to place, have contributed to introduce silex and other foreign substances, which are always met with in combination with clay.

The simple mixture of oxygen with the metal aluminum is called alumina, this being a name which is only strictly applicable to pure clay or argil. In forming alumina the two substances always combine in the following definite proportions:—

10 parts by weight of aluminum to
8 parts by weight of oxygen.

The compound is then a protoxide of aluminum, and is then properly called alumina.

The china clay of Cornwall and Devon, which is derived from the destruction of granite, is one of the purest forms of alumina. It is known that felspar, one of the principal minerals which enter into the composition of granite, contains a considerable portion of alumina, and hence the vast quantity of clay produced by the decomposition of felspar.

It has, indeed, been a favourite theory of some modern geologists, that all clay has been derived from the decomposition of granite, and of the volcanic rocks which contain alumina as one of their constituents. Whatever value may be attached to this supposition—and it no doubt has some value, inasmuch as it accounts for the formation of some very important clay districts—it only comprises what may be called one particular stage in the production of the substance which we term clay, or argil. The question raised by this theory is, in fact, simply this; whether clays have been derived directly from the combination of oxygen with the metallic base, aluminum; or whether, in the first instance, certain minerals have been formed by this combination, which minerals have entered into the composition of granitic and other igneous rocks, from the disintegration and decomposition of which pure alumina has been formed. If we conceive clay to have been derived directly from the union of oxygen with the metal, it is easy to reconcile this with the general distribution of clay, and its occurrence in beds and strata, which have evidently been transported by the water of rivers, seas, torrents, and floods. Supposing the union of aluminum and oxygen to have taken place under intense heat, either with or without the presence of water, the result would be a product presenting so little resistance to the action of water, that it would readily be transposed from the site of its original formation, and spread out in distant localities, into those beds and strata which it now composes.

If, on the other hand, we conceive clay to have been immediately derived from the minerals which contain alumina in the igneous rocks, those minerals must, in their turn, have been compounded, at some former period, out of the very same elements which are required to form pure alumina, in its plastic state. The whole subject of the composition of clays presents a field of inquiry equally interesting and important; and is not the less deserving the attention of engineers because it has hitherto been almost entirely neglected.

CLAYS OF THE OOLITIC AND WEALDEN FORMATIONS.

In the counties of Kent and Sussex there is a remarkable and well-defined basin, of an elliptical form, which is bounded by the sea, from Romney Marshes to Eastbourne, and throughout the rest of its circumference is inclosed by the elevated range of the sand hills, which emerge from below the chalk of the North and South Downs. This basin, which is called the Weald of Kent and Sussex, was anciently the site of extensive forests, and is not yet entirely cleared from the thick growth of underwood which usually remains long after the natural timber of a country has been cut down, and converted to useful purposes. The strata which occupy the surface of this basin are geologically classed under the general term of the Wealden formation, which may be described as an extensive series of clays, with numerous interspersed calcareous and arenaceous rocks. Some geologists divide the Wealden formation into two distinct members, the upper of which they term the Weald clay, and the lower, the forest series of clays, sands, and sandstones.

Adopting, for the present, this latter classification, the Weald clay may be considered as a belt averaging about six miles in width, skirting the base of the sand-hills of Surrey, Kent, and Sussex; and therefore occupying the outer part of the elliptical basin already referred to. The particular tract of the Weald clay is remarkably flat, and is consequently intersected by numerous streams; which, after a very sluggish and circuitous course, become feeders of the Medway, the Mole, the Wey, the Arun, the Adur, the Ouse, and the Cuckmere. The three former of these rivers penetrate the North Downs, and fall into the estuary of the Thames; the four latter penetrate the South Downs, and fall into the English Channel.

The Weald clay is commonly of a dull blue or brown colour, and is traversed by thin beds of a peculiar rock, called Sussex marble, which consists of a dense assemblage of small univalve fossil shells, and was formerly much used for columns, slabs, and shafts.

As the Weald clay occupies a flat belt or zone, which nowhere rises into abrupt eminences, it will commonly happen that a railway or canal which crosses it will pass over on embankment. Thus, the London and Brighton Railway, and the Arun and Wey Canal, intersect the Weald clay, either on embankment, or in cuttings of very insignificant depth. The most extensive example of a work in the true Weald clay, however, is the South-Eastern Railway, which passes through about forty miles of this formation. The principal cuttings, in the true Weald clay, are those in the neighbourhood of Godstone, and in the district between Tunbridge and Ashford. The slopes are one and a half to one in the shallow cuttings, and two to one in those of great depth. They appear to stand well, and to be perfectly dry on the surface,—an effect which is due to the numerous open and tile drains formed in diagonal directions on the face of the slope, to carry off the water falling upon it into the ditches at the foot of the cutting. This system of drainage effectually prevents the slopes from being saturated and softened by water, and consequently protects them, in a great measure, from the effects of frost, which can scarcely injure a perfectly dry surface. It obviously affords no security, however, against the pressure of water which may penetrate from the land above, either through porous beds or partings, or by means of crevices and fissures, which are commonly met with during very dry weather, in all descriptions of clay.

The agricultural character of this clay is much affected by the difficulty of drainage. The rivers and streams which flow through it pursue a very sluggish and tortuous course, with barely sufficient fall to give motion to the water. In wet seasons, all the water courses are swollen to overflowing, or at least up to the level of the adjacent lands, and hence the impracticability of providing for the discharge of artificial drainage water, unless the expedient of raising it by mechanical power be resorted to. The Weald clay, however, although possessing no superior fertility to that of any other district of cold, wet clay, is pre-eminent over every other for the growth of oak timber. This noble tree is everywhere met with in abundance throughout the Weald clay, and is in fact as peculiar to this formation in Kent and Sussex, as the beech is to the chalk of Hertfordshire, or the elm to the clays around London.

The flourishing luxuriance which marks the growth of the oak in the Weald clay, caused it to be known among the early British geologists as the oak-tree clay. This was the name assigned to it by William Smith, the father of English geology, himself a land-agent and practical agriculturist, and consequently well acquainted with the properties of soils. This clay, when mixed with a due proportion of sand, burns into a fine red brick. In the absence of sand, it does not appear to answer well either for bricks or tiles; at least the principal sites of brick-kilns and tileries are established at particular spots either where there are ridges of sand, as at Tunbridge, or where the clay contains sand mixed up with it, as in the neighbourhood of Ashford, where it passes under the green sand formation.

The other great member of the Wealden series has a physical aspect entirely different from that of the surrounding depression occupied by the Weald clay. The central mass of sands, clays, and sandstones, which have been distinguished by the name of the forest-series, in allusion to the ancient forests which everywhere covered this part of England in the days of the Saxons, is marked by great irregularity of external configuration, the surface being indented by innumerable valleys, of considerable depth, which alternate with precipitous hills of corresponding altitude. A great anticlinal axis, from 600 to 800 feet in height, runs through the basin in its longest direction, from the extreme western limits of the Weald about Hazlemere and Lurgershall, extending upwards of seventy miles, to the coast near Hastings. The real eastern extremity of the Wealden basin is in the district of the Boulounois, on the opposite coast of France, (the space occupied by the straits of Dover being a gap in the continuity of the basin,) and the anticlinal axis may be traced as distinctly in the French part of the basin, as through the Weald of this country. On each side of this anticlinal axis, the strata dip in opposite directions; those on the north side dipping to the north, and passing under the cretaceous chain of the Surrey Downs; while those on the south side dip to the south, and pass under the range of the South Downs. The clays of the forest-series are much intermixed with sands and sandstones. They vary in colour from blue to brown, but the reddish and brown varieties predominate, and are supposed to derive their colour from the presence of iron. There are few deep excavations in the forest district, which consist entirely of clay, the general section which they present being that of alternate strata of clay, sand, and sandstones. The sands are frequently ferruginous, and the sand stones are often valuable for building purposes. The cliffs, from Hastings to Hythe, present highly instructive sections of the forest series, and exhibit the formidable destruction which natural causes are certain to produce in deep cuttings through strata of this description. This part of the coast is bounded by precipitous cliffs of clay and sand, with occasional beds of very hard sandstone, well adapted for building purposes; and there is scarcely a spot where immense undercliffs have not been formed hy the action of water undermining and bringing down the ground from its original level. In many places vast heaps of spoil, to the extent of many millions of cube yards, are to be seen on the beach at the base of the cliffs, in all the confusion of a recent fall; while in other places, the vast mounds of fallen earth have been reduced to something like a regular slope, by the action of rains and waves. Everywhere, however, is to be traced abundant evidence of the absolute necessity for preventing the access of water to the soluble and pervious beds which commonly occur in extensive cuttings through the forest strata. It is scarcely possible to say what slope could be assigned as a perfectly safe one for cuttings composed, like these, of alternate beds of clay, shale, sand, and rock. It is the result of observation, that when abrupt cliffs are undermined and brought down by natural causes, the tendency to slip seldom ceases until more ground has been carried away than would have been enclosed even by a slope of 4 or 5 to 1. In other words, the ground is generally disturbed, and brought down by natural causes, in successive slips, which extend further inland than the line at which a slope of 4 or 5 to 1, carried from the original base, would meet the land above. We are not, like General Pasley, of opinion, that flatness of slope is the universal remedy which should be applied to all dangerous cases of clay cutting; because we know, from experience, that slopes which have stood for many years at a particular angle, are still liable to come down, provided the same natural causes are allowed to operate upon them, as those which have been for a time counteracted by the flatness of the slope. The Brighton Railway has considerable cuttings in the forest strata, particularly at Balcombe and Hayward's Heath. The slopes of these appear at present to be in a firm state; but experience has amply proved, that very little dependence is to be placed upon the apparent security of slopes when viewed in fine weather, before they have been subject to the trial of several successive winters, remarkable for the severity of their frost. The South Eastern Railway has also several deep cuttings through strata of this description at Penshurst and Leigh, near Tunbridge. These consist of strata of clay and marl, alternating with white sand and rock. The slopes here are 1½ to 1, and are also sound at the present time; but the same remark applies with respect to their insecurity as that already made on the Brighton Railway cuttings. Looking to the fact, that cuttings in the forest strata contain usually a considerable proportion of rock, it would seem that this might be applied with great advantage to secure the sides of the cutting, without the expense of forming flat slopes, and providing besides for the drainage, which is absolutely necessary, however flat the inclination may be. In many cases where there are thick beds of rock in the sides of the cutting, it may be judicious to underpin and support these by carrying up strong walls of dry coursed rubble from the bottom of the cutting, taking care to leave sufficient openings to discharge freely any water which may reach the back of the walls. The extent to which these underpinning walls may be carried, will depend upon the position of the beds to be uuderpinned, and the quantity of stone suitable for building, which the cutting or the neighbouring quarries will yield. It is evident, however, that in all cuttings of this description, where stone is at hand, it will be worth while to take into consideration the advantages of substituting nearly upright or curved retaining walls for the earthen slope which is usually adopted in clay cuttings. One great advantage of the walls is this, that if they are found to answer the purpose of keeping up the side of the cutting at first, they will probably continue to stand in perfect security, and not be subject to the constant danger of slipping, which is inseparable from an earthen slope. This is evident, when we consider that the walls protect the face of the slope, and preserve it from those atmospheric influences of rain and frost, which are so injurious to exposed surfaces of clay and sand.

It appears quite clear, with reference to cuttings in the forest strata, composed as they commonly are of clay and rock, that there is just as much scope for improvements in the mode of executing them, as in those of a more strictly argillaceous character, which have been already described under the head of the London clay and plastic clay.

ART. X.—OUR CLUB.—No. IX.

How pleasant 'tis when friends, long-tried,
In converse sweet sit side by side;
And wisdom, throwing off its state,
Relaxes into merry mood,
With fancy's gayest hues imbued.
Then quaint remark, and grave debate,
And quips and cranks, and mirth sedate,
With sweetly intermingling power,
Shed choicest influence on that hour.
Then, like the bee from flower to flower,
From subject we to subject roam,
And come at last well-laden home
With honied thoughts. And now, with pleasure,
We give you up our gather'd treasure.

CLUB.

SCENE.—*Club Room.*

Present, SIR JONAH, SCALPEL, *and* MONTGOMERY.

(SIR JONAH places the self-reporting box upon the table, to the orifice of which is attached a delicate membrane, shaped somewhat like a vine-leaf, and having a peculiar vibratory motion.)

SCALPEL. Ha! ha! new improvements, I see, in your magic-reporter, Sir Jonah. I know that you will never rest until you have brought it as near perfection as possible.

MONTGOMERY. I don't exactly relish the company of this insidious copyist, although Sir President *does* think it right and proper that the world should know all our sayings and doings—they having, by the agency of this box, a kind of second-hand companionship with us in our moments of relaxation, and seeing our thoughts, as it were, in undress. It is not quite so bad, it is true, as it would be were there a veritable *man*-reporter stuck at the table, scribbling down our nonsense as fast as we uttered it, and, perhaps, giving some of his own into the bargain, yet it presses on the freedom of conversation.

SIR JONAH. Don't talk nonsense then, and the world will not hear of it: your remedy is plain enough.

SCALPEL. I agree with Montgomery in protesting against the use of this invisible spy. Why, we might as well live in a glass-house at once; or have what the old Roman wished he had—or *said* he wished—our bosoms glazed, so that every passer-by might have a peep for nothing into our heart's most secret workings. Rare metaphysicians we should then be! To be able to see one another's most hidden thoughts—ah, Sir Jonah, that would beat even your invention.

MONTGOMERY. It certainly is, to a very considerable degree, subversive of that free interchange of thought—of those half-formed suggestive hints, which form, to my mind, the charm of conversation. One feels constrained; and, instead of the free-and-easy, colloquial style, our thoughts come forth in full-dress,—bob-wig, cocked-hat, and all. We cannot get rid of the unpleasant assurance (*tapping the box*) that we have—

"A chiel amang us takin' notes,
And faith he'll prent it."

SCALPEL. It is a sly, lurking demon, catching up every stray thought and incomplete suggestion as they drop from the lips, and straightway chronicling them—for what?—the good of the world?—bah! I protest strenuously against it, and vote for its expulsion, as a destroyer of the freedom of social intercourse. To your box, Sir Jonah, may be applied, with some slight changes, what Young says of Conscience:—

"——— See, from behind her secret stand
The sly informer minutes every fault,
And her dread diary with folly fills.
A watchful foe! the formidable spy,
Listening, o'erhears the whispers of our camp,
Our dawning purposes of heart explores,
And steals our embryos of thought."

SIR JONAH. Rail on! rail on! Protest, and misquote, and arguefy the topic as you may, there stands the box, and there it shall stand, in spite of all opposition. The reasons you assign for its removal, are to me reasons for its retention. So you wish to unbend yourselves, do you? You'd be on your best behaviour before Mr. Public, but you wouldn't care much what you say or do before me! A pretty compliment, truly (*majestically.*) I find that I must stand upon my dignity. Besides, sirs, you do injustice to yourselves, as well as to me, by your request, and the reasons by which you would enforce it. I know enough of you both to know that in the veriest unbendings or freest outpourings of either, there would be nothing to which the public ear would not gladly listen. While ranging from subject to subject, as the humour of the moment prompts, with free colloquial discursiveness, be ours the task, in the words of the poet-sage, (for, as you have quoted, so will I,) to find—

"Books in the running brooks,
Sermons in stones, and good in every thing."

This—this is your true unbending. I wish such a box were placed in every boudoir—at every tea-table—at every minister's levee, where fawning sycophants mould themselves, by word and gesture, into living lies—in short, in every place where men and women congregate. What a purification of society would be the result!

SCALPEL. Heaven forfend that we should ever be deluged with such a flood of nonsense and scandal.

SIR JONAH. Nay, by your own and Montgomery's showing, the scandal and nonsense would never be uttered, and therein would consist the invaluable boon which my self-reporter would confer. No! no! The box shall not be moved. On that point I am inexorable: so urge me no more.

Montgomery. I have done: your will shall be my law—as it ever has been.

Scalpel. And mine.

Sir Jonah. Well, then, in order to atone for your temporary refractoriness, you must give us a song, Montgomery. My magic-reporter is in excellent working condition to-night, and will not fail to give the words of your ditty correctly: soon, I trust, it will be able to give the tune also. Meanwhile, let us be content with its present proficiency.

Scalpel. Cannot you give us something about the journal of journals —The Artizan—or in praise of the operative arts? I should like it hugely.

Montgomery. Such subjects are not to be impromptued off in a few feeble lines; they require to be met in a grave, pains-taking manner, worthy their all-absorbing dignity. At our next Club I may possibly oblige you. At present you must be contented with a very different subject: I trust Sir Jonah will not think it too amatory for the public audience; if so, he has only to stop the clock.

Scalpel. Attention! (*Knocks on the table.*)

Sir Jonah. Pray, Scalpel, do not knock thus on the table; for by so doing, you make just so many unmeaning blots in the copy, which the compositor will puzzle his brains and waste his time in endeavouring to decipher.

Montgomery.——

The First Kiss.

When to Eliza's lips I first
Press'd mine—although the suit denied—
My bosom throbb'd as though 'twould burst,
Lest I should wound her virgin pride:
But soon my fears were all dispersed:
She did not e'en in seeming chide.
O! well do I remember how
Her face, her very neck and brow,
With burning blushes were o'erspread;
And then she gently laid her head
Like a droop'd lily 'gainst my breast.
I sued forgiveness while I press'd
Her in my passionate embrace:
She did not answer me awhile;
But, when I raised her head, a smile
Lit up by love suffused her face.
What need was there for her reply?
I read my pardon in her eye.

Sir Jonah. Ah, Montgomery, your song calls up vivid recollections of the far past. What feeling is there in the human heart, save it be a mother's love, which is half so holy, so self-sacrificing, as the passionate purity of first love? The lovers of Burns under the milk-white thorn, had, indeed, their heaven upon earth.

Scalpel. It is not often, as you can bear witness, that I deal in poetry. I have felt too much the stern realities—the prose—of life, to deal largely in the visions; yet at times my original nature resumes its sway, and my thoughts strive to mould themselves into verse. Bear, then, for a moment, with your testy, querulous companion.

Sir Jonah. In prose or poetry, your thoughts, dear Scalpel, are ever welcome.

Scalpel.——

The Inner Life.

The heart hath its own history, apart
From outward life, or held by faintest links
Thereto. While to the world's incurious gaze
Man's life rolls on in one undevious track—
To-morrow the twin sister of to-day,
To-day of yesterday—mere counterparts—
It wots not of the changes manifold
And strange that heart meanwhile doth undergo.
The man's own kindred know it not. They see
The self-same features, hear his voice the same,
Behold him wend his old accustom'd round,
Whether of gain or pleasure: thus unchanged
Without, how can they deem of change within?

Man from his fellow-man differs not more
Than from himself—the same, yet how unlike!
Sometimes by sudden outbreak comes this change
About; and with the new form'd character
New modes of life as sudden are adopted,
Making the change apparent to the world.
But, by a gentle process, oft the change
Within is wrought, having no outward sign.

What heart hath not a history of its own,
Stored with a thousand dear remembrances,
That haunt it in the busy walks of life?
At times, a tone, a glance, straightway unclasps
These records of the heart, awakening
Some memory of the past, of deepest woe,
Or fraught with incommunicable bliss.
Our heart's long-buried thoughts, in close array,
Start up before us with most life-like hues;
Again we live in by-gone times, again
Hold converse with the unforgotten dead.
Love's truest chronicle is treasured deep,
And ruffles not the surface of our lives.
As Ocean, in his tranquil mood, betrays
No symptoms of his devastating power;
Shrouding within his azure depths the wreck
Of many a gallant vessel, tempest-lost;
While, unbeholden by the eye of day,
Its coral groves, with lustrous gems well-stored,
Shine brightly: so the human heart hides deep
Its hoard of passionate remembrances.
Whether in faintest bud, or in full blow,
Or with the canker secretly at work,
Or torn at once by ruffian violence,
Pluck'd by the self-same hand that planted it,—
Deep hid within our heart of hearts, love's flower
Is cherish'd ever.

Sir Jonah. Montgomery himself couldn't have thrown more feeling into the lines.

"The heart can ne'er grow wholly cold."

So sings the bard, and its truth my own heart also avouches. It is delightful to bathe the parched spirit occasionally in the dews of Castalie,—to give the rein to the imagination, and to permit the heart to follow freely its own blessed impulses.

Enter Waiter.

Waiter. The newspapers.

Sir Jonah. Ah, this breaks the thread of our sentimentalism. Look at the paper, Scalpel, and tell me what news there is from Ireland. How does O'Connell's trial proceed? What is the general opinion—and what, may I ask, is your opinion concerning it?

Scalpel. Ireland is tranquil; but the stillness is of that kind which forebodes storm—in the moral as in the natural world; a preternatural calm, as when men keep their breath in stern resolve, at some desperate undertaking. The uplifting of a finger—one word or sign from the arch-agitator, would let the elements of discord loose, and society would be shaken to its foundations. The trial of O'Connell still drags, and bids fair for months, if not years to come, to drag "its slow length along." The general opinion concerning the propriety or the necessity for such a trial is, of course, divided—some being for, and some against it; but *all* parties seem thus far agreed, that the trial is being very badly and captiously conducted on the part of the Crown. Lastly, my own opinion is, that the prosecution involves a most dangerous infraction of the right of the people of this kingdom to meet peaceably (in whatever numbers) to complain of, and to petition and remonstrate against, whatever may seem to them a grievance. I would object the more vehemently against this proceeding, because I believe that these open meetings, these public discussions of supposed grievances, whilst they fan and keep alive public spirit, and bring public opinion to bear with incredible force against real wrongs, are safety valves by which popular discontent, not founded on fact or reason, is worked safely off, instead of being left smouldering in the breasts of the people, engendering bitter hatred and malignant spite. There, Sir Jonah. I trust your questions are answered to your satisfaction.

Sir Jonah. They are answered, as I expected they would be, clearly and with force.

Montgomery. Ireland is, indeed, an awful specimen of the evils resulting from long-continued misrule. Apart from her national discontent, ever and anon the public heart is horrified at some cold-blooded assassination,—some fierce attack on life and property, without any assignable cause. It is true, revolting murders do occasionally take place also in England, and elsewhere; but they are generally, even the worst of them, of a very different cast. The act is a solitary one, and the miscreant meets with no sympathy from the community: all are ready enough to hunt him down, and hand him over to the care of avenging justice. In Ireland, on the contrary, men band together in troops—witness the late fearful outrage in Tipperary; and when a murder is there committed, the criminal walks unmolested, in the broad eye of day; a whole neighbourhood privy to the deed and the doer, thereby making the murder to all intents and purposes theirs also.

Sir Jonah. You are right in assigning this malignancy of spirit to the misrule under which the Irish have so long grievously suffered. Everywhere, among every people, has oppression produced the like results; and a terrible lesson it is—(oh! that governors and princes would glean wisdom therefrom!) —that from the seed of misgovernment and tyranny, in its thousand and one shapes, springs up a rank harvest of hatred, cunning, and ferocity, which the tyrants must needs reap, and gather into their own garners.

Scalpel. Such fruit is ever the accursed product of slavery—for a state of slavery it is, where men are denied equal privileges and equal protection from the laws. If it were not so, "misrule" (to use the words of Shelley) "would lose half its claim to our abhorrence, as fetters which the captive can unlock with the slightest motion of his fingers, and which do not eat with poisonous rust into the soul." The poet continues referring to the revolution of 1778 in France, and its consequent enormities, in terms which are universally applicable, because universally true:—"That their conduct could not have been marked by any other characters than thoughtlessness and ferocity, is the historical fact from which liberty derives all its recommendations, and falsehood the worst features of its deformity. Could they listen to the plea of reason who had groaned under the calamities of a social state, according to the provisions of which, one man riots in luxury, whilst another famishes for want of bread? Can he who the day before was a trampled slave, suddenly become liberal-minded, forbearing, and independent? This is the consequence of the habits of a state of society to be produced by resolute perseverance and indefatigable hope, and long-suffering and long-believing courage, and the systematic efforts of generations of men of intellect and virtue." What truthfulness is here. The poets, after all, are the true philosophers in all things pertaining to the mechanism of the human heart.

Montgomery. If our view be the correct one—which I see no reason to doubt—it follows that, having trained the bloodhound, and developed to the full his ferocious instinct, we might as well wonder that he should follow unfalteringly and at length seize his unhappy prey, as that the Irish should be guilty of cruel excesses. We make bloodhounds of them, in short, and then wonder that they have an appetite for blood.

Sir Jonah. The Irish have not only been caused to hold the laws in contempt, which is a most serious evil, but, what is infinitely worse, they have been constrained also, by bitter experience, to loathe the administration of those laws. Rigorously severe, or contemptibly stupid laws may be borne, if they press equally on all; but, when justice is perverted—when that which is law to the poor man is not so to the rich—when that which is law to the Catholic is not so to the Protestant—when party-spirit pollutes the very justice-seat and jury-box—then, farewell to peace and order; insubordination will be rife, and men will take, as they have done in Ireland, the law into their own hands.

Scalpel. A reverence for the law, and, above that, a deep trust in its impartial administration, are, doubtlessly, essential ingredients in the well-being of any people. Certainly, not the least sagacious of the seven wise men of old was he who, in reply to the question as to which was the happiest state, answered, "That in which the law is supreme." The inequality of punishment often dealt out in our police-courts for the like offence, to wealth and poverty, is a serious evil, demanding instant redress. Woe to that people among whom the cry is echoed and re-echoed through the streets, "There is one law for the rich and another for the poor!" That feeling, deeply-seated and widely-spread, is the most prolific ground of revolutionary outbreaks.

Montgomery. Few things have more excited my admiration of the even-handedness and stern inflexibility of the law, than when it guards its victim—guilty, or supposed to be guilty, of some heinous offence—from the infuriated rage of the populace, protecting him with as much jealous care as though his person were sacred.

Sir Jonah. That is quite right; for, in the first place, by the British law, every man is supposed to be innocent until he be proved, before a properly constituted tribunal, to be guilty. Secondly—and this is the view in which you seem to take it—if he be guilty, the law metes out the punishment which it thinks commensurate with the crime, and inflicts that punishment itself, not leaving it to the vengeance or leniency of a mob, whose punishment would often be disproportionate to the offence, swayed by the chance humour of the moment. This is, as you say, worthy all admiration; and never does the law hold so majestic a front, and seem so like a god, as when throwing its shield, for the moment, over the supposed criminal, to protect his person, which, for the time being, is held sacred to justice; and an attack upon whom, therefore, is rightly considered to be an infringement upon the majesty of the law itself.

Scalpel. One thing in connexion with Ireland cannot fail to strike every one, and that is, the absolute sway which O'Connell has over his countrymen, a power as dangerous as it is anomalous, and the possession of which by one individual is "confirmation strong as proofs of holy writ" of all that we have been saying concerning the misgovernment of Ireland; for, without that tyrannous sway, never could O'Connell have gained such an ascendancy. Nay, we have only to see how his power has varied with the changes of the Governments, to establish this irrefutably. Once before he tried the Repeal cry: the time was different, so also was his success. His peculiar position has gained for him a notoriety unequalled by any other person. By one party he is execrated with all the frenzy of the most vehement hatred; and by others eulogized as a paragon of perfection; yea, by many, well nigh worshipped as a god. The truth, as is most commonly the case, lies, no doubt, between the two extremes. While admiring the iron energy of his character, and his comprehensiveness of mind, we should not blind ourselves to his grievous defects. In most of his writings and speeches there is exhibited too much truckling to the vulgar prejudices and inflamed passions of the mob.

Montgomery. There are certain gifted individuals who start up in every age, exactly fitted for their respective spheres, and apparently moulded for the express purpose—personifications of the spirit of their times. Such an one is Daniel O'Connell, the exact type of Catholic Ireland, and standing forth as her fierce avenger, his mind smelted—ay, literally smelted—in the furnace of her national wrongs. Like another Atlas, he sustains the whole weight of her affairs, and seems of his own will to rule the entire destinies of his country.

Scalpel. Such a despotic sway as he exercises over his countrymen, can never be obtained but by a strictly approximating principle. He is buoyed up on the stream of national sympathies, and possesses the power of lashing it into fury, or lulling it into tranquillity.

Montgomery. A being so peculiarly circumstanced is not to be measured by the standard of common men, on ordinary occasions. The man who is struggling for his country's rights may surely be pardoned, though he do not point his toe with a dancing master's precision, and though he be somewhat wanting, at times, in those punctilios of politeness which modern manners so rigorously exact, even when the duellist points his pistol at a fellow-creature's life.

Sir Jonah. It were, indeed, an absurd fastidiousness, to require all the proprieties of language from a breast overboiling with indignation. As well might we expect to see the rushing cataract wind along with the calm grace of a meandering rill. Daniel O'Connell is the crater of a vast moral and political volcano, whose explosions are not always to be regulated by the modulated impulses of an unimpassioned mind: there will necessarily be occasional terrific outbreaks in giving vent to the fervour within. For his violence let those answer who, kindling by their unrelenting oppression the fiery feelings of the Irish into a flame, have, to a great extent, made O'Connell what he is.

Scalpel (*looking over the newspaper*). Ho! Sir Jonah, here is news indeed for you. You have a rival, and a formidable one too, it would seem, in your self-reporting scheme. Listen. This is from the *Morning Post* of November 11. (Reads:)—"Alleged extraordinary Discovery in Acoustics.—A correspondent says he has received a letter from Germany, containing an account of a marvellous invention in acoustics, to be called the *vox-genic* plate, which, as the name implies, possesses a power of taking the correct impress of sounds, whether words or otherwise, similar to that of the photogenic invention for drawing. The inventor is stated to be a gentleman of independent property, named Kielmark, residing at Munich. The peculiarity of the invention consists in the preparation of the plate; which is of such a nature that when either suspended against a wall, held in the hand, or laid on a table, so as to be close to the voice of a person speaking, it displays the impress of certain characters, one of which being the necessary and invariable production of every word that can be uttered; the effect thus produced resulting solely from the concussion or cutting of the air by the voice while speaking. By this means the invention will present a sort of vocal stenography, which, it is said, may always be relied upon for its correctness, the same word having been found invariably to produce the same mark, or character, on the *vox-genic* plate."

Montgomery. Really, you must look to your laurels, Sir Jonah; or, on the very threshold of immortal fame, you will have the garland snatched from your brow. Kielmark or Sir Jonah—which will it be?

Scalpel. Perhaps it is only a trick of some scurvy knave, who, having seen the account of your Self-reporter in the pages of The Artizan, has taken the hint, and is striving to rob genius of its reward; just as it was attempted to deprive Sir Isaac Newton of the merit of some of his wonderful schemes. If such be the case, may the effort as signally fail!

Sir Jonah. It is quite possible—though I acknowledge it surprises me not a little—that the same invention should have suggested itself, about the same time, to two different individuals; and that they should, in secret, unknown to each other, have brought about similar results. It is strange, certainly, but not impossible. Indeed, many such coincidences have occurred. You know how that a printer, having brought the stereotype process to a practical bearing, hurrying up to London with the discovery, found, to his dismay, that he had just been anticipated. So also, Niepece and Daguerre had wrought long apart on the photographic scheme ere they formed their partnership. And such, likewise, may be the case with this said Kielmark and myself.

Scalpel. I was going to suggest the propriety of a partnership similar to that formed between Daguerre and Niepece; but I recollect now that the former stamped his own name on the new discovery; and I fear me that you might be similarly served.

Sir Jonah. No; let each invention stand on its own merits. If his prove to be the prior one, or superior to mine in its mode of working, and in the results obtainable from it, then I will readily and frankly yield the palm to him; but if, on the other hand, mine shall prove to have been first thought of, and first brought to a practical working, (for that is the main point,) and susceptible of a more extended and varied application, then will I as pertinaciously claim for myself the palm.

Montgomery. Would it not be advisable to take out a patent at once for your invention? Its present proved capabilities are great; and your improvement might be appended from time to time.

Sir Jonah. No, I will not patent it until it shall have been brought considerably nearer to perfection. It is not pecuniary gain I seek; and the fact of the invention requires no such proving, for is it not here at work? (*Looks into the box, and takes from it several sheets of paper, closely written.*)—Here is the proof: what more is required? And you are living witnesses of the fidelity of our invisible copyist at this and at our two preceding meetings. But its labours will soon cease for this evening; our time for breaking up is already past.

Montgomery. May I venture, Sir Jonah, to hint, that at our future meetings it would be well if some new characters were introduced. I do not assign the same reason that Goldsmith did on a similar occasion,—that we know each other's thoughts so very well, lest I draw upon myself a similar retort,—that I have not yet sounded the depths of your mind; but I think it would give greater variety, more life and zest to our proceedings.

SIR JONAH. Certainly, any gentleman whose company either of you may think would be mutually useful and improving to him and us, you are quite at liberty to introduce.

SCALPEL. I shall avail myself of the privilege occasionally by giving the right of *entrée* to my particular friend Mr. Punch.

SIR JONAH. I have received three letters, all of them from working men; one on the evils of machinery, another on teetotalism, and the other preaching up Chartism as the all-in-all. By the way of following out your idea, I shall write to each of my correspondents, desiring his attendance at our next meeting to speak for himself. So, if all three favour us with their company, we shall have, I doubt not, quite enough tongue work, without the aid of any new friends.

MONTGOMERY. I feel inclined—what say you, Scalpel?—to drink a quiet glass to the ultimate success of our president's invention over that of Kielmark.

SCALPEL. Oh! with pleasure.

MONTGOMERY. What says Sir Jonah himself?

SIR JONAH. I have not the least possible objection, and will willingly join you in so doing. But as this is an affair solely *entre nous*, we may as well remove the tell-tale of our copying clerk. (*The box is ejected.*)

ART. XI.—LIEBIG'S LETTERS ON CHEMISTRY.

Familiar Letters on Chemistry, and its relation to Commerce, Physiology, and Agriculture. By JUSTUS LIEBIG. London: Taylor and Walton. 1843.

THESE letters display in every page indelible traces of a master mind, and cannot fail, we think, to command a wide and enduring popularity. This, indeed, the attractions of the subjects discussed would, we believe, to a great extent, have secured, even had they been treated with far less ability than Professor Liebig has done; but his learning and talent will not be without their weight in raising these letters to the summit of public favour—a position of which they are in every way deserving. We have rarely met with any work in which momentous truths were more clearly or more agreeably conveyed than in this little volume. There is nothing of pedantry about it—nothing of the repulsive dogmatism of the schools; but while the matter is that of a sage, the manner is that of a gentleman. We think, indeed, that Mr. Liebig is something of an enthusiast in his art, when he assigns to chemistry the highest place in the broad field of human knowledge; but the tendency of this amiable weakness is probably a beneficial one, both in stimulating aspirants to achieve a name in so majestic a science, and in raising Chemistry to its proper rank in the public estimation. This last achievement we know of no instrument more calculated to accomplish, than such works as the one before us, which show forth chemical science not as the monopolist of hard words and trivial processes, but as one of the most powerful agents in improving the arts of civilized life, and promoting the happiness of nations. We learn from the introduction, that the appearance of this work has already had the effect of inducing the formation of several new chemical professorships in Germany—a result at which we can scarcely marvel; and although we are not exactly of opinion that the rapidity of our progress in chemistry will be in the ratio of the number of its cultivators, we do believe that this acknowledgment of the importance of the science will not be without its use in attracting to its cultivation many of those ardent and ambitious spirits who are the hereditary pioneers of improvement.

We shall not, however, detain our readers with any speculation of ours upon these subjects, but shall proceed, without further prelude, to give them some sample of the valuable wares which Professor Liebig has here heaped together. We may first, however, mention that the work contains sixteen letters in all, of which the first five treat of the Chemistry of the Arts; the next five of the Chemistry of Nutrition; and the remainder of the Chemistry of Agriculture. Letter I. treats of the materials employed for chemical apparatus; the chief of which are glass, caoutchouc, cork, and platinum. This letter is, in our judgment, a little overdone: the following, for example, borders upon burlesque:—

> "Then, how admirable and valuable are the properties of cork! How little do men reflect upon the inestimable worth of so common a substance! How few rightly esteem the importance of it to the progress of science, and the moral advancement of mankind!"

This letter also adverts to the wide field opened up to the chemist in the production of valuable substances synthetically, that is, by uniting their elements in the due proportions, which has now, in many cases, been accomplished with success. One of the most remarkable of these cases is the production of artificial Lapis Lazuli, by combining silica, alumina, soda, iron, and sulphur, in the proportions determined by analysis; and out of this artificial mineral an ultramarine is made, quite as beautiful as the natural product, and at a fiftieth part of the cost.

Letter II., among a variety of other interesting disquisitions, explains a very curious phenomenon—the condensation of air and other gases in the pores of charcoal. The explanation, which is most ingenious, and in our eyes perfectly satisfactory, is as follows:—

> "The smallest amount of a gas,—atmospheric air for instance,—can be compressed into a space a thousand times smaller by mere mechanical pressure, and then its bulk must be to the least measurable surface of a solid body, as a grain of sand to a mountain. By the mere effect of mass,—the force of gravity,—gaseous molecules are attracted by solids and adhere to their surfaces; and when to this physical force is added the feeblest chemical affinity, the liquifiable gases cannot retain their gaseous state. The amount of air condensed by these forces upon a square inch of surface is certainly not measurable; but when a solid body, presenting several hundred square feet of surface within the space of a cubic inch, is brought into a limited volume of gas, we may understand why that volume is diminished, and why all gases without exception are absorbed. A cubic inch of charcoal must have, at the lowest computation, a surface of one hundred square feet. This property of absorbing gases varies with different kinds of charcoal: it is possessed in a higher degree by those containing the most pores, *i. e.* where the pores are finer; and in a lower degree in the more spongy kinds, *i. e.* where the pores are larger."

Letter III. speaks of the manufacture of soda from common salt, and displays, in a striking manner, the numberless innovations which have flowed from that single improvement. The diminution in the price of soda gave a vast impetus to the soap and glass manufactures; and the muriatic acid, which, in the earlier stages of the discovery, was dissipated in the atmosphere during the process as a worthless product, found very soon a profitable application in the production of chlorine for bleaching. The vast consumption of sulphuric acid in the production of soda from common salt, has caused the sulphur trade to assume an importance far beyond what was to have been anticipated in the case of such a material, and that single article is now the source of great wealth to Naples. The following remarks, in reference to the attempted sulphur monopoly, we offer no apology for extracting:—

> "Science and industry form a power to which it is dangerous to present impediments. It was not difficult to perceive that the issue would be the entire cessation of the exportation of sulphur from Sicily. In the short period the sulphur monopoly lasted, fifteen patents were taken out for methods to obtain back the sulphuric acid used in making soda. Admitting that these fifteen experiments were not perfectly successful, there can be no doubt it would ere long have been accomplished. But then, in gypsum, (sulphate of lime,) and in heavy-spar, (sulphate of barytes,) we possess mountains of sulphuric acid; in galena, (sulphate of lead,) and in iron pyrites, we have no less abundance of sulphur. The problem is, how to separate the sulphuric acid, or the sulphur, from these native stores. Hundreds of thousands of pounds weight of sulphuric acid were prepared from iron pyrites, while the high price of sulphur consequent upon the monopoly lasted. We should probably ere long have triumphed over all difficulties, and have separated it from gypsum. The impulse has been given, the possibility of the process proved, and it may happen in a few years that the inconsiderate financial speculation of Naples may deprive her of that lucrative commerce. In like manner Russia, by her prohibitory system, has lost much of her trade in tallow and potash. One country purchases only from absolute necessity from another, which excludes her own productions from her markets. Instead of the tallow and linseed oil of Russia, Great Britain now uses palm oil and cocoa-nut oil of other countries. Precisely analogous is the combination of workmen against their employers, which has led to the construction of many admirable machines for superseding manual labour. In commerce and industry every imprudence carries with it its own punishment; every oppression immediately and sensibly recoils upon the head of those from whom it emanates."

Letter IV. discourses of the connexion of Practice with Theory, and also says something of the applicability of zinc as a moving force through the agency of electricity. Of this application Mr. Liebig does not think favourably. The question is one merely of expense; and Mr. Liebig computes that as much fuel is spent in the production of the zinc from the ore, as would produce the whole mechanical effect the zinc is able to generate.

Letter V. treats of the atomic constitution of bodies; and with Letter VI. begins the subject of Chemistry as allied with Physiology, wherein it is shown that all food consists of materials for nutrition and materials for warmth; the one compensating for the wear and waste of the organic tissues, and the other, by a species of combustion, keeping up the vital heat. We here again indulge our readers with an extract:—

> "Our clothing is merely an equivalent for a certain amount of food. The more warmly we are clothed the less urgent becomes the appetite for food, because the loss of heat by cooling, and consequently the amount of heat to be supplied by the food, is diminished.
>
> "If we were to go naked, like certain savage tribes, or if in hunting or fishing we were exposed to the same degree of cold as the Samoyedes, we should be able with ease to consume 10lbs. of flesh, and perhaps a dozen of tallow candles into the bargain, daily, as warmly clad travellers have related with astonishment of these people. We should then also be able to take the same quantity of brandy or train oil without bad effects, because the carbon and hydrogen of these substances would only suffice to keep up the equilibrium between the external temperature and that of our bodies."

We see from this, that the cold and hunger to which our poor in severe winters are subjected greatly aggravate one another; and by means of this key, we are also able to understand why hepatic diseases, which arise from an excess of carbon, prevail in warm climates. This subject is pursued in the several succeeding letters up to Letter XI., where commences the Chemistry of Agriculture.

The grand secret of success in Agriculture seems to lie in returning to any soil originally prolific the materials of which it has been deprived by the crops taken from its surface, or in giving those materials to soils destitute of them. A part of the constituents of agricultural produce is returned by the atmosphere—such, for example, as carbon and nitrogen—the former in the state of carbonic acid; and some of the rest, as, for example, silica, are probably to be found in the soil. But the phosphates, which are among the most essential elements, can neither be returned by the atmosphere, nor do they exist in any large quantities in the soil; and the gradual approach to sterility, or, as it is termed, the progressive exhaustion of land, is generally attributable to the loss of these ingredients.

The end, therefore, of all agriculture, is to recruit the soil with the elements abstracted from it: and in order that the atmosphere may yield its proportion of those elements, it must have free access to the soil. To afford this free access is the purpose of ploughing; and the more minutely divided the soil is by the operations of husbandry, the more effectually will the atmosphere perform its functions. The phosphates are contained in great abundance in animal exuviæ, and the efficacy of those materials in agriculture is due almost exclusively to the phosphates in them. The efficacy of bone-dust, as well as of guano, is also due to the same elements: nor is there any reason for supposing that the fertilizing property of bones is due to the gelatine they contain; the fact being, that their virtue hangs almost entirely upon their phosphate of lime. The high price, however, of bones and guano, is well nigh a barrier to their employment. A far cheaper source of the phosphates is to be found in the refuse of large towns, which might be collected if proper arrangements were made to that end.

There is, however, another source of fertility to our fields revealed to us by the recent discoveries of Geology. In the rocks about Clifton, and in a great number of other places, there are found vast beds of coprolithes (the fossil exuviæ of antediluvian animals) which there is every reason to believe will furnish an abundant and cheap supply of excellent manure. In addition to this fossil guano, the limestone marl of Lime Regis, the lias of Bath, and numerous other formations, contain vast quantities of bones. Some of these specimens have been analysed, and have been found to contain about 18 per cent. of phosphate of lime; and if these limestones be only burned, they will constitute one of the best manures we can possess. Here, then, we have an inexhaustible source of fertility, under the influence of which our agriculture may again prosper; and as England, by the power of her coal—the remains of a former *vegetable* world—has risen to the rank of queen among the nations, may she now, by the remnants of an *animal* world, be enabled to maintain that proud position!

Art. XII.—THE MANAGEMENT OF STEAM-ENGINE FACTORIES.

Upon the proper management of factories of all kinds depends the goodness of the work executed, as well as the profit of the investment. Good management resolves itself into the two qualities of skill and system; skill in knowing the best mode, and system in doing in the best manner. The greatest skill in the world may fail to realize a profitable result, if a proper system be not adopted in carrying on the work; and system, again, without skill, must be equally unprofitable, for articles unskilfully made, however good the materials, will fail to realize a good market value.

The first step, therefore, in the conduct of an engine factory is to fix upon a good plan of engine, and, before any selection be made, the person should be familiar with all the best plans of engine extant. These plans it is, we know, somewhat difficult to get hold of, for our most orthodox engineers affect to keep their modes of construction secret; yet there is no engine of which the plan may not be procured, and no trouble should be thought too great in collecting specimens of the best varieties. It will please the apathetic tribe of engineers to learn that specimens of this kind are to be given in the Artizan, as the Artizan will thus be doing for them what they ought to do for themselves.

As soon as a good plan of engine has been selected, working drawings should be made of engines of different powers, and in all these the primary form should be rigidly adhered to; nor should progressive alterations be introduced, though known to be improvements, for novelties are not merely expensive to produce, but they derange the economy of the factory. The best plan, in all cases, appears to be to let any improvements which present themselves accumulate until their amount be sufficient to justify an entirely new form of engine, and the new form should, in its turn, be adhered to until a fresh crop of improvements had been realized equal in value to the first. It is by this plan alone that it becomes possible to avoid one or other of these pernicious alternatives—a perplexed and expensive manufacture, or a gradual lapse into mediocrity.

Every engine manufactured should be drawn in the drawing-office, in all its parts, and for the accuracy of the drawing the person who made it should be responsible. It should be the part of the foreman not to design portions of the work, but to see the work properly executed, and no foreman should be permitted to alter or add to a drawing on any account whatever. Should he perceive any mistake or omission, he should come to the drawing-office, to have the requisite alteration made, but should not be suffered to make it himself. It is only by a rigorous adherence to this plan that mistakes and confusion are to be avoided, or that an accurate record can be kept of the work which has been done.

In the factories of Messrs. Maudslay, Messrs. Miller, &c., it is usual to have the drawings made on strong paper—not of the full size, but on a large scale—with the sizes marked on, a small portion being usually shown of the full size, when there is any thing delineated which it would be difficult to imitate by the measurements of a rule. This paper is usually fixed upon a board, and varnished, to prevent oil spots and other disfigurements, and a thin slip of wood is nailed all round the edges of the paper, both to keep the edges down and to prevent the drawing from being rubbed when the boards are piled upon one another.

Art. XIII.—FRESCO AND ENCAUSTIC PAINTING.

A Manual of Fresco and Encaustic Painting, containing ample instructions for executing works of these descriptions. By F. B. Sarsfield Taylor. London: Chapman and Hall. 1843.

This is an important practical work, which has manifestly had its origin in the design of decorating the Houses of Parliament with Fresco painting—an intention which has agitated to the bottom the whole generation of painters, and given a prodigious impulse to the art. Mr. Taylor first gives us a sketch of the origin and progress of Fresco painting: he next gives a series of practical directions respecting the preparation of the walls, the selection of the lime, and the preparation of the cartoon; and afterwards investigates at some length the causes to which the decay of works in Fresco is attributable. These dissertations are, as we have remarked, all practical; or, in other words, are such as will have an interest only for painters. Appended to the work, however, there is a short essay, by John Sydney Taylor, which will have attractions for the general reader, and a portion of which we extract. The subject is one that we have had on several occasions thoughts of discussing, but we fear any essay of ours would have fallen very far short of that here given:—

ON THE INFLUENCE OF THE FINE ARTS.

"The Arts that embellish society are the offspring of luxury; they grow out of that opulence which purchases pleasure through an incessant desire for novelty. It is the nature of man to be unhappy without excitement. The savage finds it in the pursuits that are necessary for his existence; the circumstances in which he is placed make him enthusiastic in search of a livelihood; his existence is poetic. The wild, uncultivated scenes of nature which he is accustomed to traverse, his dangers, his enterprises, and his athletic exercises, all tend to stimulate his stern sensibilities, and to give a vigorous impulse to the ordinary occupations of his life.

"Not so the artizan in a civilized community; he is cut off from nature; the fountain of his most healthful sensations is dried up; his sedentary, monotonous toil produces relaxation and infirmity: he is apt to become inert, sullen, and querulous, and too often has recourse to debauching gratifications, in order to procure that excitement which is so much the darling object of human pursuit.

"But that state of society which condemns a great number of human beings to the unwholesome drudgery of manufactures, heaps the means of sumptuous indolence on the heads of others. The latter have leisure and wealth; both are expended upon variety of indulgences; but the want of serious and grave occupation makes pleasure lose much of its enjoyable nature, while its name still preserves a fascination over the mind. If, then, all pleasures which grow out of luxury were gross and sensual, wherever society was luxurious there would be only depravity and enervation. But there are other sources of gratification, which are unknown to a state of nature, and scarcely heard of in the moderate prosperity of a country; which grow up and flourish in times of affluence, and give to riches a wholesome direction in the encouragement of the works of art; which preserve the memory of virtue and the fire of genius, and shed a beautiful lustre upon the highest state of literary civilization. These works render the union of the pleasures of the *sense* and *intellect* complete, and fling round art and nature the roseate bands of a delighted companionship. They define the sentiments of grace and elegance, wherever their influence is known and acknowledged; they divert the mind from sensual pursuits by the exquisite powers of persuasion, when the austere rebuke of wisdom might only hurry to the precipice; and they lead it by flowery paths to innocent instruction and refined recreation. They make tangible to our senses the purest essence of ideal beauty—they develop the heroic soul—they give form and symmetry and breathing animation to the lifeless mass, and realize the Grecian miracle, by touching the creation of their hands with fire from heaven: can their influence be truly felt, and the passions not ameliorated, and the mind not improved? It is impossible. To them it belongs to captivate the senses, while conveying generous instruction to the soul; to elevate the feelings while deeply gratifying the desire of enjoyment, and to blend with the most renovative indulgence the exciting power of 'love and rapture, of poetic joy and inspiration.'

"Wherever the arts are cultivated with success, they almost imperceptibly educate the general taste, and make politeness of mind keep pace with refinement of manners. They are to a highly commercial and opulent state of society, what chivalry was to the feudal system—they wear down its asperities, correct its selfishness, relieve the sternness of its action, enliven the dulness of its repose, and mitigate the fierceness of its enjoyments.

"When the arts are well understood, fashion cannot be so monstrous or fantastic as where they exert no salutary dominion over the fond love of variety. The source of excellence in art being a judicious observation of nature, and a right perception of her principles of symmetry and beauty, a closer adherence to nature will mark the fashions of society, polished by their ascendancy, than can distinguish the habits of people without the sphere of their influence. Hence the barbaric nations, where there is much wealth, never expend it in such a way as proves they have any notion of the pleasures of refinement. They delight in a hoarding and cumbrous magnificence; they are solicitous to dazzle with profusion, rather than please by propriety; they endeavour to attract admiration through the vulgar passion of astonishment, which is in a moment excited, and as suddenly expires, rather than create a rational respect by consulting for the praise of enlightened opinion.

"But in the classic ground of taste, how admirably is wealth employed for rational improvement! what a new and beautiful creation does it raise! the memory of which cannot perish with the vicissitudes of states, the ruins of which cannot be buried in the dust that buries power and wealth and military glory. Where now is the gorgeous dominion of Xerxes, glittering with the jewels and gold of a hundred tributary nations! Scattered on the plains of Marathon, buried in the waves of the Hellespont, forgotten and unregretted! But where the arts and eloquent fame of Greece? Surviving in her statues, exciting admiration even in her ruined palaces and temples; and where the barbarian or time has triumphed, history has saved them from oblivion, and consecrated them to an affectionate and perpetual remembrance. Thus Persia had luxury without the arts, and with her empire perished all her greatness. But the arts of Greece made her luxury open a new field to genius; and though her power has died, her empire over opinion is immortal."

ART. XIV.—THE ARTIZAN'S MUSKET.

WE do not profess to know very much about implements of war; and any thing we venture to say upon such a subject we advance with corresponding diffidence. But it has always appeared to us that the musket, even with all the improvement it has undergone, is still a barbarous instrument, and that a trivial expenditure of ingenuity would make it a much better thing. Under this impression we venture to suggest that a large amount of the weight of the musket might be saved if the wooden stock were altogether dispensed with, a light iron skeleton being attached to the barrel, or rather made in the same piece with it, to fit against the shoulder. By this plan, not merely weight would be saved—a point of itself of no small importance to the soldier; but, as soon as proper machinery was constructed for the manufacture, the expense of production would be less than in the case of muskets made in the common way. Such, at least, is the light in which the matter appears to us. We shall be glad to have the opinion of some of our military readers on the subject.

Since we have ventured upon this ground, we may as well take the occasion for saying that all cannon requisite for a campaign ought, in our opinion, to be made of malleable iron. There is no difficulty in making it of this material; nor, if suitable machinery were constructed, would the expense be much greater than at present; and there would be a prodigious saving in the weight.

ART. XV.—THE CHEMISTRY OF NUTRITION.

A Treatise on Food and Diet, with an account of Public dietaries, &c. By J. PEREIRA, M.D. 8vo. pp. 542. Longman.

Food and its Influence on Health and Disease. By MATT. TRUMAN, M.D. 8vo. pp. 231. Murray.

THE moral elevation of the working classes is a matter of supreme national importance. They constitute the nerves and sinews of our population, without whose healthful energy the state cannot prosper; and that energy cannot be fully realised, unless they become good *men* as well as good *workmen*,—persons able to feel *the dignity of their nature*, and fully conscious of having not merely *hands* for labour, but *heads* also for reasoning, and *hearts* for feeling. To urge this subject on our readers, to aim at extending the bounds of knowledge among artizans, has ever been our great and sacred purpose,—in pursuance of which we shall offer some remarks on the chemistry of nutrition, a subject not too abstruse to be made intelligible to general readers, and one also, the applications of which to domestic purposes cannot fail to improve the health and invigorate the powers of the workman, while it promotes the physical growth of his rising family; and increases, both directly and indirectly, the comfort, respectability, happiness, and dignity of himself and his whole establishment.

The works that we have selected as the groundwork of these observations differ exceedingly in character, though treating on the same subject,—the production of Dr. TRUMAN being a cursory, popularly-written, and withal amusing book on the history as well as the chemistry of diet; while the larger work of Dr. PEREIRA furnishes us with full details of chemical analysis, and a scientific distribution of the alimentary substances, that are quite convincing not only as to its author's full competence for the task he has undertaken, but also of the importance of considering the subject of food and diet on purely philosophical principles. To the latter, and more recent publication, therefore, we shall chiefly confine ourselves, premising that Dr. TRUMAN will furnish much useful as well as amusing information, and prove at the same time a faithful guide both to the dyspeptic and the man in health.

The substances employed for human food consist of certain compound bodies, termed, *alimentary principles*, (as, for instance, fibrine—the leading principle in lean meat; gelatine—the chief ingredient of animal jelly, fat, starch, alcohol, water, &c.,) which by their mixture or union constitute our ordinary foods—that for distinction's sake we may call *compound aliments*. The alimentary principles, however, being themselves compound, are again divisible into three, four, or more simple bodies, which we may denominate the *elementary constituents* or *chemical elements of food*—as, for instance, fibrine (above defined) is composed of six chemical elements*—carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulphur; while water consists of a mixture of oxygen and hydrogen—and starch is a compound of about 40 parts of carbon with 60 parts of water. Hence, it will be seen, that any really good treatise on Diet must treat separately,—1. The chemical elements; 2, the alimentary principles; 3, the compound aliments; respecting each of which we purpose giving such modicum of information as may consist with our limits.

1. *Chemical elements.* It is a principle universally agreed on by physiologists and chemists, that "no living body has the power either of creating material elements, or of changing one such element into another," (Dr. Prout's Bridgewater Treatise, p. 431)—and hence it follows that *the elements of which the animal body is composed must be the elements of its food.* On this fact rests every true theory of diet; and no mode of living can be good, which does not embrace the principle here laid down. Now, out of the fifty-five or fifty-six chemical principles that enter into the constitution of all known bodies—mineral and organised—there are *twelve* or at most *thirteen* only which are ascertained to be essential constituents of the human body; and these, therefore, *must be* the ultimate elements of our food—the good or bad quality, the plentiful or insufficient quantity of which depends on the general admixture in due proportion of the elements hereafter specified:—

CHEMICAL ELEMENTS OF THE FOOD OF MAN.

1. Carbon.
2. Hydrogen.
3. Oxygen.
4. Nitrogen.
5. Phosphorus.
6. Sulphur.
7. Iron.
8. Chlorine.
9. Sodium.
10. Calcium.
11. Potassium.
12. Magnesium.
(13. Fluorine?)

We shall confine ourselves to a few remarks on the most important of these elements, among which we may mention carbon, oxygen, hydrogen, and phosphorus, as being essential both to animal and vegetable life; while nitrogen is an indispensable constituent of all animal bodies, and powerfully instrumental in promoting their developement, growth, and renovation.

Carbon—a necessary ingredient in all animal and vegetable bodies, and therefore equally necessary in the food of both—is plentifully supplied by Nature to all the articles of food in certain definite proportions, as, for instance, according to the following table:—

Cane-sugar (deprived of its water) .	47·05	per cent. by weight.
Grape-sugar	36·36	,,
Wheat-starch	37·50	,,
Arrow-root	36·40	,,
Gum-arabic	36·30	,,
Alcohol	52·18	,,
Lard	79·10	,,
Olive-oil	77·75	,,
Wheat (dried by fire)	46·10	,,
Peas	46·50	,,
Potatoes	44·	,,
Fresh bread	30·15	,,
Beef roasted	52.59	,,
Veal ditto	52·52	,,

To what purpose, then, serves this constant supply of carbon through the food of man? To nourish every tissue of his body—his muscles, his cellular membranes, his blood—to carry on the process of respiration, to maintain the animal heat. Not a nerve, muscle, artery, or vein could exist or play its part in the vital economy without a due and constant supply of carbon in food, which carbon, after having performed its office, in maintaining the vitality of the tissues, is in great part ejected into the lungs, and there volatilized by combination with the oxygen inhaled from the atmosphere, after which it is exhaled in the form of a poisonous gas, called carbonic acid. It has been calculated that in twenty-four hours a well-drilled soldier in barracks, taking moderate exercise, consumes about 15¾oz. avoirdupois of carbon, whereas persons in confinement consume only about 10 or 11oz.; and, from the minute experiments of LIEBIG, (the great master of modern organic chemistry,) nearly the whole of these quantities are thrown out of the system by the lungs and the skin, in the form of carbonic acid. To effect this change, and for the purpose also of oxidising the hydrogen, sulphur, and phosphorus in the tissues, oxygen is constantly received from the atmosphere; and, according to Sir Humphry Davy, an adult consumes in twenty-four hours 45,504 cubic inches, or 15,751 grains of oxygen, which, by union with 4,853 grains of carbon, form 31,680 cubic inches, or 17,811 grains of carbonic acid, about one-fourth of the oxygen entering unmixed into the system, or otherwise disappearing. Carbon and oxygen perform another very important office—the maintenance of animal heat, which must be evolved in any part of the system where these gases enter into union; and if it be true that one pound of pure charcoal (carbon) evolves, by combustion in oxygen gas, sufficient heat to raise seventy-eight pounds of water from 32 to 212° Fahr., there is no reason to doubt the sufficiency of 15 or even 10 oz. of carbon in the body, when in combustion with the oxygen of inspiration, to maintain a temperature of 102° Fahr. during twenty-four hours. Now, to furnish this heat, the fuel—viz., food—must be regularly supplied; but if the food be withheld, the fat of the body (which contains 80 per cent. of carbon) is consumed, and emaciation ensues. The animal heat, also, is kept up at the same height in all climates, either of extreme heat or cold; and hence, in cold weather, when the heat is very rapidly given off, more fuel is required to keep up the internal fire. Thus we account for the fact, so familiar to us all, that more food is required in winter than in summer, and also for the enormous consumption of food by the natives of frozen climates, respecting whom such amusing stories are narrated by Cochrane, Ross, and Parry,* as well as for the kind of food to which they are most addicted, namely, fatty and oily foods, containing from 70 to 80 per cent. of the carbon required to keep up the animal fire. Much less heat, also, is evolved when there is a deficiency of food, a fact which Captain Franklin and his comrades painfully experienced. "During the whole of our march," observes he, "we experienced that no quantity of clothing could keep us warm while we fasted; but on those occasions on which we were enabled to go to bed with full stomachs, we passed the night in a warm and comfortable manner."—(*Narrative of Journey*, *&c.*, p. 424.) From the above remarks we deduce two important observations; *first*, that a proper supply of carbon, by means of *wholesome food*, is essential both to the maintenance of animal heat and the nutrition of the various structures (which otherwise would be disintegrated to supply the deficiency); *secondly*, that the internal fire cannot be kept alive without a constant supply of *well-oxygenated atmospheric gas*, a fact pointing at once to the expediency of living in airy rooms and neighbourhoods plentifully supplied with pure air and free from human miasms, putrid exhalations, &c.

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* By *simple elementary* substances, chemists mean those which have hitherto resisted all attempts to resolve them into other and simpler parts: perhaps, indeed, it would be better to call them *undecompounded* substances. The very idea of *elements* involves a power of analysing the atoms of creative matter, which man at present, at least, does not possess. What to-day we call an element, may to-morrow be analysed into two or more constituents.

Hydrogen, like carbon, is an essential of every organised tissue, and is, consequently, a necessary ingredient in the food of every animal and vegetable being. It is found, therefore, in the seeds of plants, the albumen and oil of eggs, the butter and caseine of milk. Some alimentary principles, however, contain more hydrogen than others; as, for instance, fibrine and gelatine, oil and alcohol contain comparatively more hydrogen than starch and sugar, which, again, contain more than vegetable jelly or lemon-juice. The principal use of the hydrogen seems to be, that it may combine with oxygen, and develope heat in the formation of water.

Nitrogen, or *azote*, is distinguished from carbon, oxygen, and hydrogen by the indifference which it manifests to enter into chemical combination with other bodies. It is an essential constituent of every animal tissue except fat, which is not organised; and nitrogenised foods alone are capable of conversion into blood and of forming organised tissues. To these, therefore, Liebeg has given the name of *plastic elements of nutrition*. Nitrogen, therefore, being necessary for the developement, growth, nutrition, and renovation of living animal parts, it is abundantly supplied in the food of the embryo chick, and in the caseine of milk, as well as in by far the largest portion of the alimentary substances, the exceptions comprising oil, alcohol,† acidulous principles, vegetable jelly, gum, sugar, and starch, on no combination of which can life be supported, though they perform their office in the animal economy by supporting the process of respiration, and contributing to the formation of fat, and are hence termed by Liebig *the elements of respiration*.

Phosphorus is a constituent of both animals and vegetables, an ingredient of albumen fibrine, nervous matter, bone, and the spermatic fluid; in consequence of which it is an element in the food of all animals, is a leading constituent of the yolk of eggs, constantly enters into the composition of milk, and is found in all the animal foods presented at our tables. Certain vegetables also contain phosphorus, in the form of phosphate of lime, or magnesia, as, for instance, bread, fruit, husks of grain, particularly pollard and bran, unrefined sugar, and potato.

Iron is a constituent of most, if not all, organised substances, and has been found in the ashes both of animals and vegetables. It is an essential ingredient of the blood, 10,000 parts of which are found, by repeated experiments, to contain 8 parts of the peroxide, which are equivalent to 5½ parts of the pure metal. Most articles of food, therefore, contain iron, viz., the blood of meat, the yellow fat of eggs, milk, and several vegetables.

Having thus given as explicit and succinct an account of the leading elements of food as was possible without experimental illustration, we shall give an enumeration and explanation of the principal *alimentary principles*, or simple aliments, by the combination or mixture of which our ordinary foods are formed. They are as follows:—

1. Water.
2. Mucilage, or gum.
3. Sugar, the saccharine principle.
4. Starch, the amylaceous principle.
5. Lignin.
6. Vegetable jelly, or pectine.
7. The acid principle.
8. Alcohol.
9. Oil.
10. Proteine, the principle of fibrin, albumen, and caseine.
11. Gelatine, or animal jelly.
12. Salt.

1. *Water* is essential to the performance of the vital functions in the higher classes of animals, and constitutes about 75 per cent. in weight of the entire human body, the water thus contained in the system being derived not only from the liquid nourishment it receives, but also from the moisture contained in the solid articles of food. The water in solids, or what is termed solid food, often constitutes its largest portion; as, for instance, in potatoes, 76 per cent.; cabbages, 92; lean beef, 76; codfish and sole, 79; cows' milk, 87; &c. Water serves important purposes in the animal economy:—1. By repairing the loss of the watery portions of the blood caused by evaporation and the secreting organs. 2. By being a solvent of various alimentary substances, and aiding the stomach in the act of digestion. 3. By assisting in the formation of the solid parts of the body. All waters, however, as every one knows, do not possess the same qualities; and there are three great divisions; viz., common, or fresh waters, sea-water (charged with about 3½ per cent. of chloride of sodium), and mineral waters, which are charged either with iron (chalybeate), sulphuretted-hydrogen gas (hepatic), carbonic acid (carbonated), or different salts (saline.) Our present object, however, is to furnish, in a small space, some useful information respecting the waters of household use; and of all these rain-water is by far the most pure, though no doubt, under any circumstances, charged with foreign ingredients: air is a constant ingredient of it; and another, less considerable, but more characteristic, is carbonate of ammonia, to which it owes not only its *soft feel*, but also its offensive *putrid smell*. Spring-water is rain-water absorbed in the earth, and afterwards reappearing at the surface mixed with certain salts that it finds in the earths through which it percolates. River-water, an article of prime importance to the inhabitants of most cities and towns, is a mixture of rain and spring-water, and with the exception of carbonate of lime, by means of carbonic acid, is tolerably pure after having been deprived of the foreign matters which it holds in suspension. A gallon of Thames water, which is equivalent to 70·000 grains avoirdupoise, contains 16·5 grains of carbonic of lime, 2·9 grains of sulphate of lime and chloride of sodium, with minute portions of oxide of iron and magnesia, and about 0·37 only of mechanical impurities. It seems almost unnecessary to mention, that during ebullition the carbonate of lime is precipitated on the sides of the vessel, forming the fur or crust of kettles. The mechanical impurities consist chiefly of animal and vegetable refuse, and undoubtedly these substances greatly deteriorate all the pipe water of London, though not to the extent supposed by some alarmists. Living beings constitute another class of impurities in river-water; but the aquatic animals exhibited at the Adelaide Gallery and Polytechnic Institutions are collected in stagnant pools, and not found in the water supplied by the London companies. Well or pump-water is very similar to river-water, but it contains a much larger quantity of lime and other earthy salts, being denominated *hard* water, from the circumstance of curdling soap; whereas rain and river-waters easily mix with soap, and are therefore called *soft*, being likewise more ready solvents of organic substances, as tea, malt, and other domestic infusions and decoctions. Water may be deprived of its mechanical impurities by filtration; boiling will expel the carbonic acid, and throw down carbonic of lime, but distillation is by far the most effectual method of purification. Distilled water, however, has a flat, mawkish, disagreeable taste, in consequence of the absence of atmospheric air, and usually contains traces of organic matter.

2. *Gum*, or *mucilage*, exists almost universally in plants, holding the same relation to vegetables that albumen does to animals. From some plants in particular it exudes spontaneously, and concretes on the stems of trees in the form of tears, as in the cherry and plum trees, as well as the gum trees of foreign countries. Gum is found also in certain proportions in various vegetable substances used for food. Wheat, flour, and barley meal contain about 4·6 per cent.; peas, 6·4; potatoes, 3·7; cabbages, 2·9; and kidney-beans, 19·4 per cent.! Among the fruits, gooseberries contain 0·8; pears, 3·2; apricots and greengages, 4·8; peaches, 5·2 per cent. Most of the gums are soluble in water, some few insoluble. Gum is composed of carbon, and the elements of water, in the following proportions: carbon, 42·7; oxygen, 50·9; hydrogen, 6·4;—the two last uniting to form water.

3. *Sugar*, or the *saccharine principle*, is found both in vegetables and animals, and may be extracted from all the fruits and most of the vegetables in common use, as well as from animal milk, of which it is an important ingredient. Dried carrot juice has been found to contain 94· per cent. of sugar; ripe figs, 62·5; cherries, 18·1; peaches, 16·5; apricots and greengages, 11·61; wheat flour, 7·5; barley meal, 5·2; cow's milk, 4·8; human milk, 6·5. The substance, however, commonly called sugar, is that which is susceptible of the vinous fermentation. The common sugar from the cane, maple, and

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[*] Captain Parry, in his second voyage of arctic discovery, tried the gormandizing powers of an Esquimaux lad, who was supplied, *to the satisfaction of his appetite*, with food, weighed before being given to him, as follows:—

Solid Sea-horse flesh, frozen	4¼ lbs.	Gravy soup . .	1¼ pint.
Ditto boiled	4¼	Raw spirits . .	3 glasses.
Bread . . .	1¾	Strong grog . .	1 tumbler.
		Water . . .	1¼ gallon.
	10¼ lbs.		About 1 gall. 5 pts.

[†] Alcohol is composed of carbon, hydrogen, and oxygen, in such proportion that, by its admixture with the oxygen of inspiration, water and carbonic acid are generated with the evolution of heat. Alcohol, therefore, is a fuel in the animal economy, by the combustion of which caloric is produced. In cases of exhaustion or cold, where speedy combustion is required, such fuel may be necessary; but it is obnoxious to the system in our climate, under ordinary circumstances, and when it gets into the brain or liver, without being burnt in the lungs, it exerts a most injurious influence, which, if known, would make all wise men temperate in their cups.

beet root, sugar of milk, and the sugar of fruits, are capable of crystallization; treacle, and other mucous sugars, are uncrystallizable. Sugar, considered generally, consists of 40·3 per cent. of carbon, and 59·7 of water. Sugar is readily digested by the healthy stomach, and may be regarded as a nutritious substance, especially for children; neither is there any truth in the popular notion of its having a tendency to injure the teeth, for no people on earth have finer teeth, or look better fed, than the negroes of Jamaica. The brown saccharine viscid fluid, which drains from raw sugar when placed in hogsheads, is called molasses, and is used in the preparation of brown sugar. It is imported from the West Indies in casks. Closely allied to this is *treacle*, a viscid, dark-brown, uncrystallizable syrup, which drains from the moulds in which refined sugar concretes. These liquids result from an alteration effected in crystallizable sugar, and do not exist in the sugar cane.

4. *Starch*, or the farinaceous principle, exists very generally in the roots, stems, tubercles, fruits, and seeds, of all plants; and when examined through a microscope, is found to consist of round or elliptical-shaped grains; its chemical composition being, carbon, 41·3, and water, 58·7. To render farinaceous substances digestible, cooking is required to break or split the grains, the heat of the stomach not being sufficient to burst them, while they are subjected to the rapid action of that organ:—hence they are boiled in milk or water, or else made into tarts and puddings; being, when thus employed, mild, nutritious, and easily digested articles of food. The starch substances in common use—are sago (from the pith of the palm), tapioca, and cassava powder, arrow-root, and potato-starch.

5. *Lignin, or Woody fibre*, is the basis of all vegetable tissues, and composed of carbon, 46·3, and water, 53·7: the garden-bean contains 26, the kidney-bean 19, the gooseberry 8, and the pear 2·2. per cent. of lignin. This principle can scarcely be called alimentary, but it requires notice, because it is intermingled with all our vegetable food.

6. *Pectine*, or vegetable jelly, is contained in most of the pulpy fruits, and in some of the vegetable roots used for food; its composition being, carbon, 45·1, oxygen, 49·6, and hydrogen, 5·3. Sugar helps to solidify pectine,—a property of which the confectioner avails himself in making jelly from currants and other fruits. Such jellies are easily digestible, and slightly nutritive.

7. The *acid principle* deserves mention, more from the circumstance of being comprised with other principles, than of having any nutritive qualities itself; its chief qualities, in the animal economy, being purely medicinal. The principal acid substances are, acetic acid, and vinegar; the former containing 31·, the latter 4·6 per cent. of anhydrous or undiluted acid; citric acid and lemon-juice, tartaric, malic, oxalic, and lactic acids.

Art. XVI.—QUALIFICATIONS OF A STEAM BOAT ENGINEER.

It is not book learning that is required in the engineer of a steam vessel, but care, good sense, and self-possession; and in the proportion in which he possesses these qualities is his eligibility to be estimated. For the want of assiduous care no other quality can compensate, but this quality will go for little if there be a want of skill and penetration, or timidity in the hour of danger. A vast number of lives are in the engineer's hand, and such a responsibility should only rest upon one who is prepared to try all things and to dare all things when the occasion is such as to demand his energies.

The attention to the feeding and blowing-off of the boilers is the engineer's most important duty. In sea-going vessels blowing-off should be practised every two hours, that is, twice every watch. It is a mistake to suppose that this frequent blowing-off diminishes the pressure of the steam, for although there is more water to heat in consequence, the difference is more than made up by the greater facility with which sea-water yields steam than concentrated brine. Besides, unless the blowing-off be frequent, the depositure of scale on the flues so impairs the conducting power of the metal that a large quantity of the heat which would otherwise enter the water, escapes up the chimney.

There is no more important qualification of a nautical engineer than to be prepared with remedies for all the conceivable disasters likely to happen to steam-vessels at sea. Thus, if the vessel were to spring a leak, the obvious resource would be to open the injection from the bilge; but suppose that both injection-hoses were to become choked with coal-dust within the condenser, as we have known under such circumstances to happen, what should be resorted to then? In such a case the injection should be admitted through the shifting valves, supposing the water high enough to reach them, the condensation being thereby accomplished in the air-pump instead of the condenser. Again, suppose the eccentric catches were to give way—a thing by no means unfrequent—it is pleasant beforehand to know that the proper motion will be given to the slide by the lever of the opposite engine, or by the cross-tail butt or connecting-rod of the same engine, and every engineer should settle in his own mind, after a survey of the engine with which he has to deal, what expedient he would adopt in such an emergency.

Art. XVII.—PROMISCUOUS NOTES ON ARCHITECTURE AND BUILDING.

The backing and hearting of walls.—In designing and constructing heavy masses of masonry, such as dock walls, abutments, piers, moles, breakwaters, and retaining walls of every description, too much attention cannot be paid to the method of hearting or filling in the interior of the work. By the more experienced members of the engineering profession, and particularly by those of the old school, who acquired their knowledge of construction from the noble aqueducts and bridges of Rennie and Telford, the importance of this subject is thoroughly understood and generally acknowledged. Amongst the modern engineers, however, who in their eager haste to complete the works with which they are charged, carry on their operations at a far swifter pace than their predecessors, we find this and similar precautions often lamentably neglected. We trace the consequences of this neglect in some thousands of friable railway bridges and viaducts, many of which will be tumbling to pieces in twenty years hence; to say nothing of a sea wall occasionally being washed away, or a river pier falling down, because its foundations chose to step out of their places.

In specifications for heavy masonry, it is usually provided that the front ashlar shall be of sufficient size, shall be properly dressed with level beds, and that the joints shall be squared at right angles to the face. All this is very good as far as it goes; but the specification is obviously incomplete, if it leaves the backing or hearting to be composed at the discretion of the contractor, of any kind of rubble which the most convenient quarry will furnish. In the absence of any particular provisions on this subject, the rubble will be packed in at the back of the ashlar in pieces of all shapes and sizes; and then, in order to save mortar, the interstices of the rubble will often be filled with the chippings, or with any smaller pieces of rubble which may be at hand. It is quite clear that a wall built in this manner, with dressed stones only in front, and any kind of small detached fragments behind, (or within, if the wall has two faces,) can possess very little more strength, and offer very little more resistance, than if it consisted of the front stones only. Such rubble work, in fact, only adds to the strength of the wall by its weight, in the same way as if it were a mass of loose sand opposing a certain resistance to any force attempting to overturn it; and obviously there is no principle of cohesion brought into operation, unless the mortar used be so excellent, and the mixture with the small stones so perfect, as to convert the whole backing or hearting into a kind of concrete. In many cases, however, no such trouble is taken as that of using even common mortar with the filling in; a common practice being that of pouring liquid mortar or grout over the hearting at various stages of its progress. It may safely be asserted, that a full century would be required for this liquid mortar to become hard in the interior of a work where it is excluded from the action of the atmosphere, and hence may be readily seen the perfect uselessness of such a proceeding, and the consequent truth of the conclusion, that the ordinary filling in, or backing of walls, affords no other resistance than that derived from the mere weight of the substance made use of.

In all important works of masonry, it is not sufficient merely to specify that the ashlar is to be fairly dressed on the free beds and joints; but it should also be particularly directed, that the blocks of ashlar are to tail out and present as full and square a surface at the back as in front. The ashlar being thus prepared and placed in the work, the filling in should consist of squared rubble stones, laid in regular courses, of the same depth as that of the front stones. These squared rubble stones require no other dressing than the mere scabbling performed by the quarryman; but they should not be less in length than one and a half times their depth, and they may with advantage be of as large an area as can be procured. The stones should break bond, and be laid as close to each other, that no stone could be moved from its place without dislocating those adjoining. It may sometimes happen, that a quarry will not furnish stones of such a size as will enable the contractor to make the backing courses of the same height as the front ashlar course. In this event, it should be provided, that the requisite height of course must be made up by means of what may be termed two sub-courses. Thus, if the front ashlar be laid in courses of twelve inches, and such size of stone cannot be procured in sufficient quantity for the hearting, it may be allowable to substitute two courses of six inches, or one course of eight inches and one of four, in order to make up the equivalent thickness of one foot to suit the front ashlar. A projecting pier, formed in this way, will be capable of resisting for years the wildest lashings of the sea, whose impetuosity would, in a very short time, demolish one of less substantial construction. Such a pier owes its strength to the solidity of its mass, the interior consisting of squared stones evenly laid, and in the same courses as the front, the whole forming one compact and solid body, and no one part of which can be removed or destroyed, except by a cause sufficiently powerful to destroy it *en masse*.

In the case of a sea wall, built with an imperfect hearting, one violent shock from a wave, or a severe blow from a vessel, might displace some of the front ashlar; and this once effected, a passage is soon made by the sea into the heart of the structure, the whole interior is rapidly washed out, and the speedy demolition of the whole work may be expected.

Art. XVIII.—PROMISCUOUS NOTES ON STEAM MACHINERY.

Equilibrium Slide.—A slide valve has been submitted to us by Mr. Meriton, the purpose of which is to neutralise the pressure thrown by the steam on three ported or vacuum valves, to the end that a valve of this description may be easily worked, though of large dimensions. The manner in which the equalization is effected is by applying on the back of the valve, which is of course flat, a steam-tight ring, the edge of which presses against the inside of the valve casing and maintaining a vacuum within this ring. The area of the ring being nearly the same as the area of the port, neutralizes very nearly the pressure against the face the steam would otherwise occasion.

This plan is ingenious, and would be efficacious; it is, however, not new, though we do not doubt that it has been re-invented by Mr. Meriton. In some of Mr. Penn's engines a contrivance similar in effect to this has long been employed, and in some of the later engines of Messrs. Rennie a plan identical with that proposed by Mr. Meriton has been introduced with perfect success. It is necessary to the proper action of the plan that a communication should be maintained between the space within the ring and the condenser, either by means of a small pipe or a hole through the valve. The most minute leakage would otherwise occasion an accumulation of steam within the ring, which would produce as great a pressure of the valve on the face as if there was no such expedient as the ring at all.

ART. XIX.—DURHAM JUNCTION VIADUCT.

WE have been under the necessity of deferring the publication of an engraving of the centering of this bridge until the present time. Plate XXXII. shows the mode adopted in the disposition of the timbers of the frame-work. The design is that of Sir John Rennie; and the works were executed by Mr. Gibbs, of Aberdeen. "The viaduct," says a correspondent, in a rather grandiloquent description of the structure, "is thrown over a deep, romantic valley, at the foot of which the river Wear rolls on its course towards the sea. The structure is founded upon the solid rock; and, at the time of our visit to the spot, the sight of the operations in progress was truly imposing. The piers were carried up to their heights, and the rings of the principal arches were on the eve of being closed. The whole scene appeared like a forest of timber, in the midst of which stood the gigantic form of the building, surmounted by the lofty frame-work and machinery above, with the massive centering underneath. On the summit of a range of towering piles, on each side of the bridge, lay horizontal plates of timber, forming a skeleton railroad, upon which travelling machines were plying alternately, from place to place, bearing with them immense blocks of stone, suspended in the air, and moved forward to their place of destination with an apparent degree of ease and facility which at once bespoke the ingenuity of man."

The whole of the masonry of the piers, abutments, arches, and spandril walls, is composed of ashlar stone, worked fair and true on the beds and points, every stone bonded with each other alternately, by leaders and stretchers.

The thickness of the ringstones of the principal arches is four feet six inches; the outside spandril walls are four feet in thickness, the intervening space being subdivided into cavities each three feet in width, and separated by interior spandril walls, three feet in thickness, placed six feet apart from centre to centre. These walls are built upon inverted arches, which rest immediately upon the haunches of the principal arches, distributing their weight uniformly over the surface of the arch. Upon the top of the spandril walls, and immediately underneath the roadway, these cavities are enclosed by semicircular arches, which serve the purpose of supporting the roadway. The interior spandril walls are further supported by transverse walls, three feet in thickness, placed fifteen feet apart from centre to centre.

The foundation of the centre pier is bedded upon the freestone rock, forty feet below the level of the ground line. The coffer-dam used for this purpose was composed of strong piling, having on the river side a double tier of piles, forming a clear space of five feet six inches in width. The space between was excavated down to the rock, and the interval filled in with pounded clay, rammed hard, so as to render the trenches impervious to wet. The whole of the piles were strongly supported by waling beams, and strutted from the interior by strong frame-work.

ART. XX.—FACTS FROM THE CENSUS.

1. *Reports of the Census Commissioners for* 1841:—1. England and Wales;—2. Scotland;—3. Ireland.—*Published Oct.* 1843.
2. *Registrar-General's Fourth Annual Report.*
3. *Registrar-General's Quarterly Table of Mortality in* 114 *English Districts.*—*Oct.* 1, 1843.

THE close connexion subsisting between the population of a country and its productiveness, wealth, and prosperity, has long been perceived by political economists; and so important has it been thought to possess an accurate account of the numbers, age, condition, health, and average mortality of persons forming a political community, that in nearly all the civilized states of the world periodical enumerations are made, sometimes with the simple view of ascertaining the mere number of people comprised in them, but in some cases with the more extended and philosophic object of ascertaining their ages, occupations, domestic condition, and estimated property. The Jews, the Greeks, and the Romans, all more or less saw the importance of such an enumeration; but especially the latter, among whom a quinquennial census of the people and their property was taken during more than eleven centuries of their national existence. In the middle ages, indeed, when states were constantly unsettled, and depopulated by wars and pestilence, the means for making such estimates were too scanty to allow of much exactness, even if their value had been acknowledged; but since the settlement of Europe within the last century, the means have been increased, and arrangements been made for furnishing pretty accurate periodical enumerations of the people in the various states. In France and Belgium this census is taken every five years; in Prussia triennially; in Great Britain, Ireland, and the United States of America, every ten years,—the information procured by the enumerators differing according to the instructions of the Act made for carrying it into effect.

Previous to 1801, the only method of ascertaining the population of Great Britain was by a comparison of the births and burials: in fact, a merely approximative method, not susceptible of exactness, and giving no information whatever on the means of subsistence, occupations, and domestic condition of the people—subjects highly important when viewed in relation to vital statistics. As, however, such estimates of the population at different periods anterior to the regular enumerations are curious historical documents, strikingly illustrative both of the vast increase of the people, and also of their means of subsistence, we shall cite, with the authorities, some of the earliest returns and estimates that we have been able to discover respecting England and Wales.

End of 11th century .	(Domesday-book)	2,150,000	
1377 . . .	(Poll-tax Returns)	2,540,000	
1570 . . .	Calculated by Mr. Rickman from the Parish Registers.	4,123,708	
1600 . . .		4,811,718	
1630 . . .		5,608,517	
1670 . . .		5,773,646	
1700 . . .		6,045,008	
1750 . . .		6,517,035	
1801 .	Enumeration Returns .	8,872,980	
1811 . . .	Ditto	10,150,615	Decenn. rate of incr. 14 per cent.
1821 . . .	Ditto	11,978,875	. 17¼ "
1831 . . .	Ditto	13,897,187	. 14 "
1841 . . .	Ditto	15,906,741	. 13⅔ "

It will hence be seen that the rate of increase has greatly varied; but it may be assumed as a general principle, that *the population of our country doubles itself in about forty-five years.* The rate of increase, however, varies very much according to districts and occupations; the agricultural counties increasing much slower than those remarkable for mining and manufacturing industry. It is important to show this fact; for it proves the immense and growing importance of our industrial, artizan population, and points to the folly, nay, the wickedness, of enacting laws for the exclusive benefit of corn-growers, to the incalculable injury of at least eight millions of people engaged in or dependent on our manufactures, which thus are shut out from the continental market, by reason of high and fluctuating wages, resulting from the present corn-laws.

1. AGRICULTURAL COUNTIES.

Counties.	Population in 1841.	Increase per cent. since 1821.
Bedford . . .	107,936	27·0
Berks	161,147	20·8
Bucks	155,983	15·4
Cambridge . .	164,459	32.2
Cumberland . .	178,038	14·9
Devon	533,460	20·8
Dorset	175,043	19·9
Essex	344,979	18·6
Gloucester . .	431,383	26·4
Hereford . . .	113,878	9·4
Hertford . . .	157,207	19·6
Huntingdon . .	58,549	19·0
Kent	548,337	26·4
Leicester . . .	215,837	22·5
Lincoln . . .	362,602	26·2
Norfolk . . .	412,664	18·7
Northampton .	199,228	21·0
Oxford	161,643	17·2
Rutland . . .	21,302	14·9
Somerset . . .	435,982	20·8
Southampton .	355,004	23·9
Suffolk	315,073	15·3
Surrey* . . .	582,678	41·8
Sussex	299,753	27·0
Westmoreland .	56,454	9·5
Wilts	258,733	15·7
York, except W. Riding . . .	437,379	18·8
WALES, except Glamorgan . .	740,415	9·1
Total of Rur. Dist.	7,985,176	20·5

2. MANUFACT. AND MINING COUNTIES.

Counties.	Population in 1841.	Increase per cent. since 1821.
Chester . . .	395,660	42·3
Cornwall . . .	341,279	30·4
Derby†	272,217	25·7
Durham . . .	324,284	49·7
Lancaster . . .	1,667,054	51·7
Middlesex . . .	1,576,636	35·0
Monmouth . .	134,355	72·9
Northumberland†	250,278	24.2
Nottingham . .	249,910	30·9
Salop*	239,048	15·0
Stafford . . .	510,504	43·3
Warwick . . .	401,715	42·3
Worcester† . .	233,336	25·4
W. Riding of York	1,154,101	40·2
WALES.		
Glamorganshire .	171,188	59·2
Total of Industrial Districts	7,921,565	45·9

* Surrey, which comprises Southwark and Lambeth, is placed among the agricultural counties, because by far the largest portion in extent is of a rural character. Salop, on the contrary, on account of its coal and iron mines, is classed among the industrial counties, though on other accounts it should be classed with the rural counties. It is impossible, in grouping large districts, always to attain perfect accuracy. Northumberland, Worcester, and Derby,† also, comprise fewer artizans, in proportion to the whole, than any others in Division 2.

This table speaks volumes respecting the importance of the artizan population of our country; and there surely exists a moral power in these mighty masses, which, if quietly, judiciously exerted, must procure the reform of such notorious and generally acknowledged grievances,—grievances too that may be materially lightened (on the fixed-duty principle) without in the least injuring the agricultural interests. Here in the first division we have a widely scattered rural population, occupying 40,538 square miles, or more than two-thirds of the soil, though they constitute considerably less (if we substract artizans in retail business) than half the population of the country, increasing at a rate of less than 20 per cent. in twenty years, whereas in the second,—and that too consisting of rural, as well as industrial sections, (which we have not ready means of dividing,) we have the great producers of all that gives us our paramount commercial importance, a densely-crowded, industrious population of nearly, very nearly *eight millions in fifteen counties only* (for we exclude the rest) occupying not quite a third of the country, and increasing at the rate of 46 per cent. in the same period. Let us, however, refer to our great industrial towns, and we shall there see, notwithstanding the depopulating influences of town life, a far higher ratio of increase than any one would suppose possible,—a ratio which, if (as Malthus and Mc Culloch maintain) it outstrips the power of producing subsistence, still indicates a high degree of productiveness, and consequently of national importance, loudly calling for the consideration of the Legislature. In the great cotton-mart of Manchester, for instance, which comprises 296,183 persons, the augmentation since 1821 has been 77 per cent.; while its busy port of shipment, Liverpool (264,298 in 184) has increased 83 per cent. in the same period. Birmingham exhibits, during the same time, an enlargement of 67, Leeds 71, Sheffield 55½, Preston 86, Oldham 80, Wolverhampton 82, and Bradford 126 per cent., in the last 20 years: and it would not be difficult to cite still more striking instances of rapid increase by immigration, owing to the great increase of manufacturing industry. In Scotland, also, we observe the same increase; for, while Edinburgh increased at the rate of only 19·7 per cent., the populations of Glasgow, Paisley, and Dundee, rose at the rate of 73, 46, and 83 per cent. respectively.

There are many other facts, of great interest, deducible from this enumeration an abstract of which is now before us,—facts which may, at our leisure, be presented to the reader in an easily intelligible shape; for the machinery of 1841, though far from perfect, was much more complete and comprehensive in its scope than that of any preceding census year. One point, however, to which we call attention with great satisfaction, is the domestic improvement indicated by the statement, that "the *inhabited houses* have increased in a greater ratio than the *population*, both in England and Wales;" the proportion per cent. of inhabited houses to population, in 1831, being only 17·85, or 5·6 persons to each house; whereas, in 1841, the proportion of the former to the latter was 18·5, or only 5·4 persons to every house. Such is the result for England and Wales, showing that while the number of inhabited houses has risen at the rate of 18·6 per cent. between 1831-41, the increase of population has been only 14·5 per cent., although it was 16 per cent. in the period of 1821-31. But it is important to show that this increase of house-accommodation applies to the manufacturing districts; and we find that there has been a positive improvement in all the north-midland and north-western counties, except Warwickshire and the town of Liverpool, while the metropolis has slightly retrograded. It may be said, indeed, that the amount of improvement is trivial; but, in times of depression, we are delighted to see any at all; and look to it as an earnest of a better state of things, to be brought about by stringent, comprehensive sanitary arrangements. And surely, if the wealthy are concerned for the good lodging and diet of their horses or hounds, kept chiefly for pleasure, they ought to be deeply, feelingly concerned for their fellow-Christians, by the sweat of whose brows they principally obtain the luxuries and importance that constitute an English merchant's pride. Yet these men and their families are now living and dying in mere dog-holes; and these, too, the property of the very individuals, whom their labour enriches and makes influential. We blush for the conclusions so obviously deducible from such undoubted facts,—and hope that the Quarterly Returns, and Annual Reports of Mortality, may soon furnish evidence of an increased attention to the health of the people. Let us not look exclusively, however, to the dark side of the picture; for if we compare the present state of the poor with their condition two or three centuries ago, we shall find that the comforts of *all* classes of our countrymen have been wonderfully augmented, and none more than *the labouring classes;* besides which hundreds of persons in humble life have succeeded in advancing themselves to the more important posts in society which, in this country, are ever the rewards of laborious, ambitious merit. To state a few facts; less than a century ago, very little *wheat* was consumed in the northern counties of England,—and in Cumberland particularly it was common for the principal families to use a little about Christmas as a kind of yearly luxury,—whereas at present throughout our towns and villages no other bread is ever tasted, and even among the rural labourers in remote districts, wheat is almost as much used as barley, or any other farinaceous article.* With respect to animal food, also, it may be safely affirmed that the consumption of butchers' meat since 1750, has been more than double, as compared with the increase of the population; for on an average of ten years, at the former period, the number of cattle annually sold in Smithfield amounted only to 74,000 of the average weight of 370 lb., and that of the sheep to 570,000 weighing 28 lb. each, whereas in 1831 the cattle sold each year for three or four previous years amounted to 156,000 of 800 lb. each, and the sheep to 1,238,000 of 80 lb. each,—thus showing an improvement in breed and quality, as well as mere numbers and weight. But this estimate includes not the carcases and foreign meat sent to the London-market; and on the whole we are disposed to think our view of the improvement as understated rather than exaggerated. The increase in the consumption of tea, sugar, coffee, &c., since the same period has been quite unprecedented. In fact, the poorest are now daily enjoying many kinds of luxuries, which a century and a half ago were unattainable even by our wealthiest nobles. Tea and sugar are now become necessaries of life; every cottage is now well furnished with glass-windows; the rushes which covered the floors of palaces in the good old times of Queen Bess, are now supplanted even in the humbler abodes of the poor by neat Kidderminster carpets, and the poorest domestic servants are quite as prettily, if not so expensively dressed, as the courtly duchesses who figured in the days of Queen Anne. Into the state of crime at different periods it is not now our intention to enter; but aged men can recollect when London and its environs were not safe after dark, when highway-robberies were committed in our most crowded thoroughfares, when travelling was unsafe, and life was almost as often sacrificed as property:—the state of things is, indeed, altered; a vigilant police now acts in *preventing* as well as detecting crime, and the value both of life and property is much increased, while the painful labours of the judge, the sheriff, and the hangman are proportionally lightened. Similiar observations apply with equal force to the public health, which has been most wonderfully improved, on the one hand, by better diet and accommodation acting as a preventive of disease; on the other hand, by the mighty strides which have been made by the science of medicine. This fact is abundantly shown by the table of deaths in the liberties of London at six different periods; and hence it has been deduced that the annual deaths out of 100,000 living were as follow:

1629 — 1635	5,000
1660 — 1679 (plague years)	8,000
1728 — 1757	5,200
1771 — 1780	5,000
1801 — 1810	2,920
1831 — 1835	3,200
1840 — 1842	2,500

Fever, plague, cholera, and dysentery, constituted 4-10ths of the diseases, killing annually three per cent. of the population,—five times as many as are now killed off by consumption, while small-pox, now happily soon to become extinct, proved fatal to 5 out of every 1000 inhabitants. Fever and small-pox have, according to Mr. Farr, declined nearly in the same ratio, for in the three periods 1771—1780, 1801—1810, 1831—1835, the deaths from fever decreased as 621 : 264 : 114; those from small-pox as 502 : 204 : 83. With respect to typhus, indeed, we know from the old writers that it once visited England as an annual epidemic, slaying one out of every three who were attacked,—whereas now it rarely prevails epidemically (except in Scotland), and proves fatal to only one in eighteen of those attacked. Consumption and other organic diseases have decreased, though in a less ratio; nor can there be any doubt that the diminution will be regularly progressive, till we arrive at a minimum, if only exertions be made to maintain the physical and moral energies of the useful laborious classes of our community.

Having made these general, but certainly not unimportant observations, on the Census for England and Wales, we proceed to make a few remarks—and they shall be brief—on the returns from Scotland and Ireland:—and here let us pause to note the vast immigration of Irish into all parts of Great Britain. This immigration, indeed, is so extensive, that there were in 1841, in England only, 284,128 Irish, of whom 94,000 were in London, Manchester, and other parts of Lancashire, as well as Cheshire; in Wales there were 5,200 (chiefly in Glamorgan); and in Scotland there were 126,340 (principally in Lanarkshire), comprising about a twentieth part of the entire population. This immigration, too, of the inhabitants of a poor, ill-conditioned country into our own exercises a most pernicious influence on the condition of English labourers and artizans. "Pauperism," says McCulloch, "will, like water, find its level. It cannot be heaped up in Leinster and Ulster without overflowing upon England and Scotland. The process of equalization has already commenced; and at this moment a very large proportion of the labourers in the west of Scotland and England consists of Irishmen, who are everywhere supplanting our own poor in those departments of industry in which strength is more important than skill. A double injury is in consequence inflicted on the native population of Britain; for in the first place their wages are reduced by the competition of the Irish, and in the second place their opinions with respect to what is necessary for their comfortable and decent subsistence are lowered by the contaminating influence of example, and by familiar intercourse with those who are content to live in filth and misery. This influx is, indeed, only just commencing; nor will the tide of beggary and degradation cease to flow in this direction until the plague of poverty has spread its ravages equally over both divisions of the empire." (*Notes to Adam Smith's Wealth of Nations*, vol. iv. p. 154.) Some observations to this effect were made in our article, No. 2, on the Health of Large Towns; and it is pleasing to be confirmed by so eloquent and forcible a writer as McCulloch.

The population of Scotland has increased at a slower rate than that of England, its rate being only 23·7 per cent. in twenty years, whereas in our own country it was 30·5 per cent. during the same period, the last returns giving 2,620,184 persons spread over 26,014 square miles,—that is about 100 persons to a square mile. So unequally, however, is it inhabited, that while in Argyll, Inverness, or Sutherland, there are not more than 18 or 20 persons to a square mile, in Lanark, Renfrew, and other lowland counties, a single square mile comprises from three to four hundred inhabitants. The influence, also, of manufactures on population is as strongly seen in Scotland as in England; for whereas the *total* increase of the former country in 1831-41 is nearly 11 per cent., it will be found that if the counties be separated into two classes, the industrial counties have increased at the rate of 28 per cent., and the districts purely rural only at $4\frac{7}{10}$ per cent., a rate nearly agreeing with the general increase of Ireland during the same period.

		1831.	1841.	Increase per cent.
Manufacturing counties	Dumbarton	33,211	44,295	33·3
	Forfar	139,606	170,400	22·
	Lanark	316,819	427,113	34·8
	Renfrew	133,443	154,755	15·9
		623,079	796,563	27·8
	The rural counties	1,742,035	1,824,047	4·7
	Total	2,365,114	2,620,610	10·8

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* In 1760, there were no less than 880,000 persons in England and Wales who were fed on rye; whereas, at present, with a population two-and-a-half times greater than at the former period, there are not 20,000 rye-eaters,—*i. e.* in 1760, 1 in every 7, and in 1841 only 1 in 795,—a very remarkable test of improved condition and strength!

The census of Ireland has been prepared with meritorious care, and, if report speaks truly, at a most lavish expenditure:—the volume however, a very bulky one, is full of highly valuable matter, and the attached medical report of Surgeon Wilde contains such a mass of information on medical statistics, most comprehensively and learnedly treated, that it will be referred to in future years, long after the returns shall have lost their value. We have drawn up a very brief summary of the great provinces and their inhabitants, and shall add a few words on the civic districts:—

Provinces.	Extent in square miles.	Population in 1841.	Inhabited houses 1841.	Population per square mile.	Increase per cent., 1831—41	Persons to each house.
Leinster..............	7,472	1,973,731	306,459	264·1	3·36	6·4
Munster..............	9,187	2,396,161	364,637	260·	7·6	6·6
Ulster..............	8,450	2,386,373	414,551	282·5	4·37	5·7
Connaught...........	6,765	1,418,859	243,192	209·7	5.6	5·84
All Ireland	31,874	8,175,124	1,323,839	254·1	5·2	6·13

It must be borne in mind, however, that although the average of inmates to houses is little more than in England (5·4), yet the houses are much inferior—often little better than mud huts, without chimnies or windows, and unfit even for cattle; nay, only about 1-6th are what in England would be termed decent inhabitable houses. Of this population somewhat less than one-eighth is of a civic character; and here we find 7·5 persons to each house. Let us refer, however, to Dublin (232,726 in 1841) and we find 11·7 persons, whilst in Galway (17,275) there are 8, in Cork (80,720) and Limerick (48,391) 9·2 persons to each house. The decennial increase appears very small,—a proof of the low productive powers of a degraded, ill-fed, slovenly, lazy population, shut out by bad laws from the influence of manufacturing industry. Disease, also, induced by miserable lodgment and insufficient potatoe diet, exerts undoubtedly a very powerful influence on the mortality; though to what amount the manifestly very incomplete returns of the deaths will not allow us to form any conclusion. Emigration drains the country of about 400,000 yearly, and upwards of 100,000 favoured Great Britain with a long visit between the years 1831-41.

We have thus, in as small a space as the subject admitted, given a general view of the more important facts deducible from the census; and they prove most forcibly that, in a vastly productive and commercial country like England, population and production keep hand in hand. Increased education, too, will produce more of that moral restraint which shall hinder over-population through early improvident marriages; the character of our countrymen, indeed, is a sufficient warrant for this supposition.* What need we fear, then, from the geometric progression of increase since 1801, or from the fact that the people are doubling their numbers every forty-five years? Twice as many families may, it is true, require to be maintained; but there are also twice as many active labourers creating food and capital for their families, twice as many miners and manufacturers ready to send our goods into every corner of the world, and twice as many inventive minds trained to the discovery of truth and the invention of new methods for increasing the general stock of human happiness. These are the truths we would develope, and the more the laws of national life and death—population and mortality are studied, the more must the mind be impressed with the duty of extending the national health and life to their very longest span, promoting, in every possible way, its active usefulness, and multiplying "the safeguards by which it has been surrounded by God and the laws."

Art. XXI.—THE SOCIETIES.

Most of the learned societies have resumed their sittings for the season, but hitherto they have done little more than sound the notes of preparation, announce the presents received during the vacation, and elect additional members. We commence our sketch of their proceedings with the

Society of Arts.—On the 8th of November a paper was read on the means proposed for preserving life in shipwreck, by Lieutenant Irvine. There is nothing very worthy the name of invention in Lieutenant Irvine's proposition, which is, that trunks should be made floatable by an exterior air-case, and that handles or straps of leather should be fixed to them, to which the passengers and crew might cling. The trunks are proposed to be made so buoyant that thirty persons might be kept afloat by a single one. At the meeting on the 15th, Mr. Elkington's process of coating iron with zinc and copper by galvanism, formed the chief subject of interest. In Mr. Elkington's plan crystallised sulphate of zinc is dissolved in water, in the proportion of one pound to a gallon. The surface of the iron is first well cleansed, by being put into diluted sulphuric acid, and scoured with sand; it is then immersed in the zinc solution and connected with the negative pole of the voltaic battery. Plates of zinc, connected with the positive pole of the battery, are also placed in the solution, near to the articles to be coated, and in a short time the iron is perfectly coated with the zinc. The process adopted when the iron is to be coated with copper is varied by employing a solution of sulphate of copper and copper-plates, instead of the solution of zinc and zinc-plates. The adhesion of the metal coating is so firm that bolts of the plated metal have been driven through oak planks, twenty-four inches thick, without detaching it in the least.

The Ethnological Society.—This society, which is yet in an embryo state, commenced its meetings on the 22nd of November. Its objects are the study of the varieties of the human race, similar societies having been for some time past established on the Continent. A paper, by Dr. Hodgskin, on the progress of ethnology, occupied most of the evening. The important question, is man derived from more than one original stock? was considered at great length. Though Blumenbach was of opinion that there are five distinct races, subsequent researches, aided by philology, had shown that some of those which had been classed as distinct races, were originally the same, and Dr. Hodgskin was of opinion that the differences in the human race might be attributed to changes of climate and circumstances, and that all the varieties of man proceeded from the same original stock, in accordance with the statement of the sacred historian. At the conclusion of this paper, laws for the future regulation of the society were agreed to, and the president and council were appointed.

The proceedings of the Society of British Architects, of the Geographical Society, and of the Geological Society, do not present anything which it would interest our readers to record.

London Institution.—A course of lectures, by Mr. Grove, is proceeding at this institution, of which the first was delivered on the 13th ult., on the relation of physical forces to each other. Mr. Grove conceives that all the properties of matter, such as heat, light, electricity, chemical affinity, magnetism, and gravitation, are identical with motion, that any one of those forces is educible from the others, and that, like matter, the original force is incapable of annihilation. Motion, when once communicated, he conceives, can never be stopped without generating, to an equivalent degree, other modifications of the same force—heat, for example. When two moving bodies, therefore, come into collision, and are mutually stopped, the force of their collision generates a quantity of heat, which is capable of producing an amount of moving power equal to that of the two bodies before their impact. This theory seems to resemble somewhat the curious notion of Mr. Babbage, who, in his *pseudo-Bridgewater Treatise*, assumed that every motion and sound might be perpetual, and that one of the punishments of the wicked on the day of judgment might be to hear their own words and the sounds of their acts when in this world constantly repeated; so that the assassin would be for ever appalled with the sound of the blow that killed his victim!

French Academy of Sciences.—A report from M. Leway, on the analysis of a vegetable wax from China, was read on the 30th October. This wax, which is perfectly white, does not melt at a less heat than 82·5 centigrade, which is equal to 180° of Fahrenheit's thermometer, and its boiling point is higher than that of mercury. In its chemical properties it bears much resemblance to bees' wax. The results of some experiments by Messrs. Calvert and Ferrand, on the decomposition of carbonic acid by vegetables, were reported to the academy. They have ascertained that the decomposition of carbonic acid is continually going on when plants are exposed to the light, whether it be in diffused light or in the direct rays from the sun, but that the decomposition is proportional to the intensity of the light, and the absorption of carbon is in the ratio of the vitality. Messrs. Calvert and Ferrand have also ascertained that ammonia exists in vegetables in a state of gas. In pursuing their researches from the food of plants to that of fishes, they come to the conclusion that the chloride of sodium (common salt) contained in sea-water is an aliment necessary to the life of marine animals, and that it exerts on them a similar stimulating action to that of oxygen on land animals. At the meeting on the 5th ult. a curious phenomenon which some plants have been observed to exhibit was brought before the notice of the academy. It consists in the spontaneous revolving movements of the leaves, which are remarked by close examination. The leaves of the common pea, when the plant is beginning to shoot upwards, have been noticed to revolve in this manner. The motion is not caused by the action of light, but it is attributed to an internal vital excitation, the nature and object of which is not understood.

Statistical Society, Nov. 20.—*Influence of Employment on Health.*—The chief business of the evening's meeting consisted in the reading of a valuable paper, by Professor Guy, M.D., of King's College, London, on the influence of employments on public health. The subject—which is, undoubtedly, one of no mean importance—was admirably treated in a previous paper, now printed in the August number of the society's transactions; and the present forms a third paper in a series, founded on the principle of concurring probabilities, from about 5,000 cases occurring in King's College Hospital practices, and from very nearly 10,000 cases drawn from the mortuary registers of the metropolis. This paper itself is too long to analyse, much less to exhibit to advantage by the aid of the numerous statistical tables so ingeniously arranged by the author, but we shall state some of the chief results, which, after all, are the points most interesting to the general reader. They are as follow:—

1. The proportion of cases of pulmonary consumption to those of all other diseases is highest both among men and women, but more especially the latter, in those following sedentary employments, tailors, shoemakers, staymakers, milliners, &c., less in those having mixed in-door occupations, such as joiners, book-binders, carvers, factory labourers, &c., and least of all in persons employed out of doors, the ratio being always greatly increased by irregular habits of life.

2. The ratio of cases of pulmonary consumption to those of all other diseases, in the case of persons employed in-doors, is less in occupations requiring strong exercise than in those merely sedentary, though bronchitis and brain affections kill off the former very rapidly in later life.

3 Neither constrained posture nor exposure to high temperature and a moist atmosphere in the workshop appear to have any effect in promoting pulmonary consumption. Thus tailors, shoe-makers, commercial clerks, bakers, engineers, stokers, carpenters, whitesmiths, glass-cutters, hatters, and dyers, form groups not less unhealthy than others occupied in in-door employments, though the habits of some of them are notoriously dissolute.

4. The proportion of cases of consumption to those of all other diseases, is highest in the case of men who are compelled by their employments to inhale dust, the cases

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* This, however, is not mere matter of speculation; for the marriage-registers of the four last years exhibit a progressive diminution in the marriages, both of men and women, under age, and incapable of writing their names. Thus prudence and education seem connected as cause and effect.

of consumption in sawyers, stone-masons, and knife-grinders being about three-eighths of all diseases.

5. The ratio is high in cases of persons habitually intemperate, the proportion being as two to five of other diseases. Indeed, the tendency to early death from general causes is made abundantly evident by a most curious table, showing the curves of mortality incidental to livery-servants, publicans, porters, draymen, and potboys, in all of whom the chance of longevity most essentially differs.

6. Consumption attacks persons at different ages, varying with their employments; earlier in in-door and passive employments than in out-door, laborious employments; whereas, in later life, the powers being exhausted, the out-door labourers die off quicker than *the survivors* of the in-door work-people.

7. Generally speaking, the date of superannuation is earlier in men engaged in *laborious* occupations than in men whose work is merely sedentary, requiring sharp sight and manual dexterity: thus compositors will live to sixty-five, while pressmen will die at fifty-six, although many of the former die from consumption in middle life.

Lastly, sedentary employments are proved to be unfavourable to health in the many, but favourable to longevity in the survivors; whereas, laborious occupatious are favourable to youth and manhood, but unfavourable to old age—a disparity that might be greatly lessened by regular, *self-imposed* exercise by the sedentary, and a less love of gain by the *prudent* laborious artizan.

Such are some of the most important deductions to be drawn from Dr. Guy's papers. They will be published, doubtless, in the forthcoming number of the *Statistical Journal*, and may there be perused at length by our readers.

ART. XXII.—INVENTIONS OF THE MONTH.

The Archimedes Screw applied to Ventilation.—There is great virtue in a name, consequently the name of Archimedes may be of much use in introducing a plan invented by Mr. Day, of ventilating buildings, and of even airing smoky chimneys, by the "screw." Its operation is, in fact, the same as that of the common fanner; which it is proposed to keep in action by steam power where available, and where that cannot be conveniently obtained, by a train of wheels connected with a drum, acted on by a cord and weight. In some situations a rotating screw or fanner for obtaining a mechanical ventilation may be of great service. It is proposed, for example, to apply the apparatus to the ventilating pipes of the engine rooms of steam-ships. In those instances the rotatory motion may be readily obtained, and the effects are said to be most satisfactory. Not only is the temperature considerably reduced by the constant current of cool air that is introduced, but the fire, it is stated, burns better and with less consumption of fuel. This, however, we doubt; but the application of the plan to the ventilation of the cabins would produce far more benefit than any increase in the draft of the furnaces.

A Gas Ventilator.—When a man of Professor Faraday's eminence directs his attention to the improvement of the useful arts, we reasonably expect some important results. When, therefore, his gas ventilator was announced, it was received with all the favour to which, from his name, it was deservedly entitled. There is a vast difference, however, between the discovery of a scientific principle, and its practical application; consequently, we often find that an invention beautiful in theory, is of little value in practice. Even the safety-lamp of Sir Humphrey Davy was, in its original state, of comparatively little use, in consequence of its obscuring so much light. The invention of Dr. Faraday is liable to the same objection. The ventilation is produced by employing a double glass chimney, the outer one being closed at the top, and connected at the bottom with a pipe or flue to conduct the products of combustion from the chamber into the outer air, or the chimney. By this method the vapour, the carbonic-acid gas, and the unconsumed carburetted hydrogen are all effectually carried off, but the depositions of vapour and of carbon on the outer glass materially obscure the light; and unless some plan be adopted to prevent these depositions, the value of the invention must necessarily be much diminished.

Galvanic Illumination.—It has been long known that two pieces of charcoal when placed in the circuit of a powerful voltaic battery, produce a most brilliant and beautiful light, which does not arise from the combustion of the charcoal, but it appears to be caused by the light-exciting power of electricity. The employment of this light for illumination has been often contemplated, but the expense of exciting the requisite voltaic power has hitherto prevented its practical application. M. Archereau, of Paris, is said to have overcome that objection, and to have rendered voltaic illumination so practicable as to threaten to extinguish gas. The Place-de-la-Concorde, where one of the lights was tried, was more effectually illuminated with one voltaic than with twenty gas burners. We are not informed, however, of the means employed for exciting the electricity, and without that element of the invention, its feasibility cannot be determined.

A Gas Engine.—Dr. Drake, of Philadelphia, has contrived a gas engine, which is said to be in many respects superior to steam, and to occupy only half the space of a steam-engine. The gas of course requires no boiler, and, as it is generated from resin, or from spirits of turpentine and *whiskey*, the gas can be "got up" in a minute, and in full action. Of the cost of working this engine we are told, that one of three-horse power can be maintained in work for an hour with a pound and a half of resin. We have, however, heard so many wonderful accounts of engines, electro-motive and otherwise, from across the Atlantic, without any realization, that in the absence of more specific data than have yet reached us, we have no fear of steam being superseded by whiskey gas.

Printing by Sound.—We now hear from Germany of the completion there of an invention which about three years since was stated to be in embryo in Manchester; the object of which is to impress the sounds of a speaker's voice on paper or other substance. We know not whether the foreign invention be the same as the Manchester one, but the accounts received of it appear very similar. It is well known that the vibrations communicated to the air by the voice, communicate corresponding vibrations to elastic bodies at considerable distances, therefore it is not impossible that the various vibrations may be rendered visible, and made to leave permanent indications. Printing by sound, at all events, does not appear a more extraordinary performance now than painting by light would have appeared five years ago. The latter we have seen successfully accomplished, and we cannot deny that the former may be done. At present, however, we are not acquainted with the *modus operandi*, though we observe, from printed announcements, that a gentleman is about to deliver a lecture on the new art, called *Phonography*, when we may hope to be in possession of the means of taking the whole of a discussion, or of a lecture, home in our pockets, for consideration or study at future opportunity. A reporter of this kind would be useful in Parliament, though even there it might sometimes be inconvenient to have the words printed exactly as they are spoken. We say nothing of our own achievements in this line for the present—the truth being that we have little ambition to be known as the inventors of any thing.

Shoe-Making Machine.—Our ingenious brethren across the Atlantic are said to have in operation a machine for making shoes that will almost supersede manual labour in that very useful art. The apparatus, we are informed, makes, in the first place, a number of suitable iron wire screws, and by subsequent processes the upper leather is screwed on to the sole, and the screws are cut off, so that the only thing left for the workman to perform is to rivet the ends of the screws, and to finish off. This appears to us an inferior method to the plan devised by Mr. Brunel.

A Steam Blast.—Several attempts have been made to apply a blast of steam effectually to furnaces, so as to render the oxygen and hydrogen of which water is composed available for promoting combustion, but hitherto we believe with indifferent success. A patent has lately been obtained for an improved method of applying steam in blast, which consists in first heating the steam to a temperature of 600°, which is equal to a low red heat. The steam, at a pressure of 60lbs. to the inch, issues through a jet three-sixteenths of an inch in diameter, and is admitted into the tuyère at such a distance as to permit it to carry with it a quantity of atmospheric air, to supply a greater proportion of oxygen to the fuel than the steam contains. This arrangement is said to greatly improve the combustion of coke, and to facilitate the smelting of iron; but we do not believe that it will do either.

ART. XXIII.—ANALYSES OF BOOKS.

The Dictionary of Trade, Commerce, and Navigation. London: W. Brittain. 1844.

This Dictionary is a sizable octavo of considerable pretensions, as indeed the title page bears evidence, for we suppose it is called *The* Dictionary of Trade *par excellence.* But the quality is in the inverse ratio of the pretension; and, to say the truth, we have seldom met with a more trumpery production. To say that it is a mere compilation, is perhaps little disparagement in these bookmaking days; but it is a bad compilation, full of inaccuracies and nonsense. We do not know where the writer may have been *caught*, but we would venture to suggest to him that it is *something* more difficult to write a Dictionary of Trade and Commerce than to sweep a crossing. We might afford our readers some amusement, perhaps, by a few extracts from this notable work, could we only reconcile it to our conscience to encumber our pages with such heterogeneous rubbish; but this we cannot do, and the fact is, so poor a devil as this compiler is not worth powder and shot.

Adcock's Engineer's Pocket Book, for the year 1844. London: Simpkin, Marshall, and Co. 1844.

We have here another blessed piece of dulness—a flower of the *papaver* genus, which blossoms yearly, to make engineers smile and schoolboys yawn. This pocket book is composed for the most part of a set of antiquated tables, among which that everlasting table which begins with "Greatest cold produced by Mr. Walker," occupies a prominent place. In the whole compass of the book there is not a single statement of the least worth or novelty; and the old errors—such as that which tells us that a cylinder has least cooling surface when the stroke equals twice the diameter—and which have been repeated year after year with the most conscientious exactitude, these errors are of course retained in their primitive integrity. This pocket book is vastly inferior to that compiled by Mr. Templeton, noticed in a late number of the ARTIZAN. Such mediocre productions as this, indeed, are not to be tolerated; and now that there is a better pocket book to be had, we trust that engineers will show their discernment by having nothing to do with Mr. Adcock.

The Mechanics' Almanack, and Engineers' Year Book for the year 1844. London: Printed for the Company of Stationers.

This is a very creditably executed little work, and will, we are convinced, be very acceptable to mechanics of every denomination. We shall here set down a list of its contents.

The first 14 pages are occupied by a good plain almanack; next comes a list of the patents granted during the current year; and after that, an account of the Act for the Registration of Designs, with a table of the expense of that operation. Then come a variety of useful tables, not such as are met with in every schoolboy's book; and after that there is a brief description of the several inventions which during the year have attracted the largest share of attention. There are also some short interesting articles given on the condition of the working classes, on life assurance, and other subjects, some of them original, and some selected from other works, but all interesting to the mechanic. Altogether, this work is an excellent one, and as such we commend it to the notice of our readers.

A SURVEY OF THE PERIODICALS.

The ARTIZAN has, we believe, met with as large a share of praise from the critics as most periodicals which ever issued from the press; and, to say the truth, we believe it to be the least contemptible, perhaps, of the scientific magazines. But this is only slender praise, and whoever else the work may have satisfied, it has, at least, never satisfied ourselves. It is too monotonous for one thing, and has never yet devoted to the several subjects in which artizans feel interested the quantity of space due severally to their importance. There are, moreover, numerous traces of haste and inattention to be met with in every number, and no trace at all of that incessant contact with the world without, which ought to mark such a publication. These are serious faults; but the first step in improvement is to be sensible of the need of it, and we are seriously intent on the elimination of these deformities as soon as may be. We are not fond of promising anything, but we think we may venture to say that the ARTIZAN will become less and less unworthy of the high character it has already earned, and the high hopes which have been formed of it.

By the way of relieving the monotony we have indicated, and at the same time keeping our readers abreast, at least, of the information of the day, we propose to give in every number a summary of such of the contents of all the other periodicals as might be supposed to interest our readers. This summary must necessarily be a brief one, but will nevertheless be sufficiently comprehensive to enable us to give a tolerably clear account of all articles which may be presumed to be of importance to the persons the ARTIZAN addresses. Our readers will thus be apprized not only of what is passing in their own narrow circle, but of what is passing in *every* circle, and will either be spared the purchase of a vast number of periodicals to reach that information, or directed to such as may happen for the time to have some attractions for them.

1. *The London Journal, and Repertory of Arts, Sciences, and Manufactures.*
2. *The Repertory of Patent Inventions.*

These two publications closely resemble each other, their objects being the publication of the specifications of patent inventions; and, if properly conducted, they would be extremely valuable. A complete record of the progress of invention is much wanted, for many are the years of labour and thought often wasted in endeavouring to perfect inventions which have been previously attempted, and perhaps patented. Neither of these publications, however, answer that purpose. They are conducted rather with a view to promote the patent agency business of their proprietors, than to inform the public fully respecting recent inventions. In the first-named publication especially, the specifications are comparatively old, some of them having been enrolled upwards of two years. Neither of them attempts to give a record of all the specifications, whilst those that are published seem to have been selected from other motives than their public utility.

The Electrical Magazine. No. 2.—The science of electricity is now becoming so important, not only in a strictly scientific point of view, but as a mechanical agent, that it well deserves to have a periodical publication of its own. This second number of the *Electrical Magazine* contains a great store of curious facts, and of accounts of interesting researches in electricity, calculated to develop the actions of that mysterious agent. The publication, however, bears evidence that England is yet far behind the continent in the attention paid to the means requisite for the advancement of this science; for most of the papers are translations from foreign works. We are obliged even to go to France to learn what is doing in England; one of the best articles in this number being a translation from the *Archives de l'Electricity* of a memoir, by M. de la Rive, on the study of electricity in England. In this memoir mention is made of many ingenious applications of electro-magnetism by Professor Wheatstone, which were shown to M. de la Rive during a recent visit to London. Among them is a method of registering variations in the barometer and thermometer by the action of electro-magnetism connected with clock-work. In this contrivance, which is represented as being very complicated, though perfect in its operation, the rise or fall of the mercury in the tubes is made to break or complete the galvanic circuit, and thus brings into action an electro-magnet, which serves, in connection with the clock-movement, to register the height of the mercury. The pages of this magazine afford abundant evidence of the rapid strides that electricity is making, and of the vast and rich field which it opens for scientific cultivation, whence we may ere long expect to reap fruits, both practical and theoretical, of the utmost value.

The Magazine of Science. Part VI. New Series.—This is a very useful little publication, but it is principally made up of compilations from other works, and treats the subjects in an elementary manner adapted to general readers. The proceedings at the late meeting of the British Association for the Advancement of Science occupy a large portion of the pages of this part.

Tegg's Magazine of Knowledge and Amusement. No. VII.—This magazine puts forth many pretensions; it undertakes "to promote the happiness of society, advance the interests of religion, virtue, and humanity, and encourage a spirit of industry, perseverance, and economy amongst all classes." It is composed for the most part of the ordinary kind of magazine literature, somewhat more serious, perhaps, and descriptive than usual, but without any other claim to distinction. The only article at all in our way is one describing the properties of sulphur, but it contains nothing new.

Chambers's Edinburgh Journal, Part 138.—The railway union of England and Scotland, is one of the subjects taken up with interest here. The claims of Edinburgh to a direct line of communication with the metropolis are stoutly maintained, and we are told that a company has been already formed in Edinburgh, to promote the formation of the *North British Railway*, which is to extend from Berwick-on-Tweed to the north bridge in Edinburgh, a distance of fifty-six miles; the connecting line, from Newcastle to Berwick, being left for completion by English capitalists. It is supposed this line will be finished within the space of five years, and that the journey between London and Edinburgh may then be made in one summer's day of fourteen or sixteen hours. We are glad to find that the North British Railway Company are about to proceed more economically with their works than the railway companies in England. Availing themselves of the experience already obtained, they will suit the gradients to the nature of the country through which the line passes, and by avoiding useless ornament they have resolved, "that although the line shall be made perfectly substantial and efficient, not a sixpence shall be expended unnecessarily, *the great object being* (and here comes a more bare-faced avowal of *the great object* of railway-projectors than is usually thought prudent to state) to make a good working line at a cost which will ensure *a handsome return to the shareholders*." The public accommodation is not alluded to as one of the objects of this honest spoken Scotch company.

Dublin University Magazine, No. CXXXI.—Many clever and useful articles are at times to be found in this magazine of the sister kingdom, but the present number is taken up with purely literary and political articles, which are out of the province of the ARTIZAN.

Blackwood's Edinburgh Magazine, No. CCCXXXVII.—*Blackwood* almost always contains something worthy of a careful perusal. Crotchety, violent, and coarse he too frequently is, nevertheless there are in the midst of his crotchets, his violence, and his coarseness, a brilliancy of imagination, a kindliness of heart, and a compass of learning, which reconcile us to these deformities, and compel us to love the 'old man eloquent' in spite of his unamiable characteristics. The number under review has several articles abounding with useful information. The commercial intercourse between the Atlantic and Pacific oceans is the title of one, in which is considered the practicability of opening a communication across the isthmus of Panama into the Pacific. The writer seems to be well acquainted with his subject, and to have personally surveyed the tract of land which divides the two oceans, and the result at which he arrives, from an acquaintance with the country, and with the nature of the shore, is that the most feasible way of carrying on communication between them is by railroad. The difficulty of connecting the oceans by a ship canal in his estimation lies principally in the shallowness of the water on the Atlantic shore, but this obstacle it appears to us would be also an impediment to the formation of a railroad, which would, of course, require harbours at either terminus. It appears, by a survey made for the purpose, that the bevels of the waters of the Atlantic and Pacific are nearly the same, and that it is high tide on both sides the isthmus at the same time. The chain of mountains which extends through North and South America, as the back-bone of that continent, breaks at the isthmus for a few miles, and thus affords facilities for either plan of connecting the two seas. A ship canal, if practicable, and there appears little doubt of its being so, would, certainly, be most convenient, but it would at the same time be much more expensive than a railroad; and the cost, conjoined with the prospect of a profitable return, must be the guiding principle. It is proposed, that the different governments of Europe should subscribe for the construction of this general way for all nations, and that it should be considered their joint property. Such a proposition is rational enough, if we had any specific for ensuring the peace of the world in all time coming; but the arrangement seems scarcely compatible with the supposition of possible war.—An article on commercial policy endeavours to defend by detailed calculations the advantages of colonial trade against the attacks of Mr. Cobden, and the advocates of free-trade. It appears from these statements, that, independently of other advantages attending the colonial trade, its actual amount is greater than that with foreign states; and that the goods exported to the colonies are wholly manufactured in England, whereas the goods exported to the continent consist for a great part of twist and other articles, intended to supply foreign manufactures.—Ceylon and its history affords the subject of an interesting article, though coarsely written in the swearing style of composition in which *Blackwood* too often indulges. The island of Ceylon is represented to offer advantages to all classes of emigrants far greater than South Australian possessions, and it is now completely under British rule.

Frazer's Magazine, No. CLXVII.—An article entitled "Architectural Revivalism and Puginism," is devoted to demolishing Mr. Welley Pugin's recent work, *An Apology for the Revival of Christian Architecture in England*, if such an operation can be supposed possible after the annihilation the ARTIZAN inflicted. The reviewer deals with Mr. Pugin's conceit and dogmatism as it deserves, and whilst admitting, as every one must, the justice of his censures on many of our public buildings, he shows the folly of the very unsparing and discourteous attacks made on every existing architect. Mr. Pugin, in his zeal for Catholicism, would have every building, for whatever purpose, resemble in its style of architecture the gothic cathedrals erected during the reign of the Church. He is, however, rather difficult to please, otherwise the many gothic cottages, perched up and down the country, would at least have been looked on with an eye of favour as attempts, at great personal inconvenience, to introduce the "pointed style." Mr. Pugin, however, calls these little enormities, "Brummagem Gothic," and he would introduce the pure style with its little windows that obscure the light in street architecture and shops! Few absurdities can go farther than this crotchety notion of gothic shops. The tendency of the present age is already too much towards copying our ancestors, without considering whether ancient forms are adapted to existing circumstances; but we hope that the climax of folly, recommended by Mr. Pugin, will never be perpetrated even in this wicked and perverse generation, which, with all its faults, has yet had virtue enough to resist Mr. Pugin and his "light of other days."

The Gentleman's Magazine, Vol. XX., No. V. new series.—Here is a publication after Mr. Pugin's own heart; a literary antiquity which resolutely resists the onward march of intellect, and is almost ashamed of having been induced to appear in roman typography, instead of its more suitable black letter. It also has been labouring against modern innovations in architecture, and has been greatly eloquent about little matters. The present number contains nothing worth our notice, and only affords us the opportunity of saying that the publication, though destitute of talent, maintains its character for respectability. This is now, we believe, the only magazine that attempts to give a summary of the events of the month, and it will be welcome to many readers on that account alone.

Tait's Edinburgh Magazine, No. CXIX.—Railway reform is one of the subjects handled in this number, and the writer joins in the widely extending protest against the sacrifice of public interests and convenience, to the gain of a comparatively few individuals. The interference of the government, indeed, becomes every day the more necessary, as the monopoly extends, and places travellers at the mercy of commercial companies, who having no competition to fear extort as much from the public as they think can be obtained without injuring the traffic. The most pressing grievances are the regulations for the annoyance of the second class, and more especially of the third class passengers, to compel them to pay for the dearer accommodation. Why should not there be third class carriages attached to every train? On many of the lines there are but two trains a day in which third class passengers are taken, and means are adopted, apparently purposely, to detain them on the road, and to make the journey as inconvenient as possible. On this subject the writer remarks: "In no more glaring and obnoxious way is the selfishness of railway companies displayed than in the impediments thrown in the way of the poorer classes of travellers, or of those who find it necessary to sacrifice both comparative comfort, or luxury, and vanity to economy, by using the third class trains. And this also holds, in a less degree of the second class trains. By every expedient, and even by trick, travellers are forced if possible into the most expensive trains." The loud reclamation in every quarter against such grasping injustice must surely have its effect ere long.

Colburn's United Service Magazine, No. CLXXX.—Our business is not with war either by sea or land, but in these "piping times of peace," when swords have been turned into ploughshares, and cannon have been cast into ornamental statues, even the literature of war assumes a peaceful form, and military and naval matters, if not forgotten, are mingled with other topics of more useful interest: and soldiers and sailors instead of recounting their deeds of arms, narrate their explorations of unknown lands, and their expeditions for the extension of the arts of civilized life. The *United Service Magazine* affords a fitting medium for such communications, and the present number is not deficient of its quota of information derived from those sources. We pass, however, from them to a "Narrative of the Niger Expedition, 1841, 1842," compiled from official documents, for the purpose of extracting the following *morceaux*, descriptive of the superstitions of the Ibu people, with whom it was one of the objects of the expedition to enter into friendly treaty: "It appears but too true, that human sacrifices were offered by them, and that in the most barbarous manner. The poor devoted victim is tied by his legs, and dragged from place to place till he expires, when his body is cast into the sea. Infanticide was likewise committed, and was of a peculiar kind; the origin or cause of which could not be ascertained. *Twins were never allowed to live;* as soon as they were born, they were put into two earthen pots, and exposed in the forest. The unfortunate mother, in addition to the anguish of being thus cruelly bereft of her infants, was ever after exposed to troubles and hardships. A small hut was built for her in the bush, where she had to submit to many ceremonies for her purification, and remained separated from society for a considerable time. Her conjugal connexion with her husband was for ever dissolved, and she was never after permitted to sit down with other women in the same market, or in the same house. To give birth to twins was, therefore, justly considered the greatest misfortune that could befall a woman. Another of the superstitions of the people is, that if a child happen to cut his top teeth first, it would be a very wicked person in after life, if it were allowed to survive, and it is, therefore, invariably put to death." In the treaty which was entered into with this barbarous people, it was stipulated, in an additional article, that human sacrifices should be discontinued.

The Nautical Magazine and Naval Chronicle, No. 11.—There is in this number the continuation of an important article on the "Mariner's Compass," by Mr. Walker, R.N., in which he attempts to explain, and apparently satisfactorily, some of the causes of the deviations of the compass, which have hitherto remained unaccounted for. Mr. Walker contends that the iron in a ship is magnetic, and that the position of the vessel, as it lurches in rough weather, alters the direction of the attractive force, and produces derangements which have not hitherto been taken into consideration, and may sometimes materially affect a ship's reckoning. A correspondent in this number directs attention to the want of a well-understood system of lighting steam-packets, and he attributes many of the collisions of steam-boats in the night time to the absence of all system in the mode of placing the lights.

The Artist and Amateur's Magazine, No. 8.—*The Art Union*, No. 59.—Each of these publications is devoted to the promotion of the fine arts, though in somewhat different ways. The former, which has more external pretensions, is edited by Mr. Rippingille, and it is occupied with philosophical dissertations on art in its various branches. The latter is more of the nature of a journal of art, and comprises notices of passing occurrences, as well as abstract treatises. In an article in Mr. Rippingille's work on the comparative merits of British and foreign art, he gives the palm to England, in all the requisites for painting of the highest order. The foreign artist is asserted to be decidedly inferior in portraiture to the English, and fails in giving animation and nature to his characters in historical or scriptural subjects. The figures of the foreign artist are condemned as unnatural, and he is said to fail even in portraits, in elevating his subject, though the merit of accuracy in drawing is conceded. "How is it to be accounted for," asks Mr. Rippingille, "that British art, possessed of such superiority, does not claim and obtain the first consideration, and the highest honours conceded to art?" To this question he furnishes the answer, a short and plain one: "*Because it is only employed upon subjects of an unworthy and inferior character.*" Or, in other words, the power and the ability exist, but they want encouragement in the proper direction to call them forth.

We have many periodicals still on our table unnoticed, but our survey has already extended over as much space as we can this month afford.

ART. XXIV.—MARVELS OF THE DAY.

Porcelain made by Machinery.—We have inspected a very ingenious machine, devised by Mr. Wall, and now in operation at Mr. Whitworth's Foundry, at Manchester, by which plates, cups and saucers, and other delf or porcelain articles are made with great accuracy and expedition. We forbear giving any description of the mechanism just now further than saying, that it is automatic, or in the artizan phraseology, self-acting, and we have not seen any such mechanism which more admirably performs its functions.

Anomaly in Steam explained.—In one of the former numbers of the ARTIZAN it was stated, that on an occasion where the engines of the Blackwall Railway stopped, from the steam having been permitted to get low, the steam at the instant of the stop had regained such an elasticity as to raise the cylinder escape valves: and we stated at the time, our inability to account for such a phenomenon. A correspondent suggests that it may be accounted for in this way:—when the pressure of the steam fell, the engine of course went slower, and the probability is, that during the time the quantity of injection was not diminished, the engine in such case must have become choked with water, and the vacuum consequently become so vitiated as greatly to diminish the effective pressure on the piston. This defect would go on increasing until the engine came to a stand, and in the mean time the pressure of the steam would rise, from the diminished expenditure at the slow speed, but this increased pressure of the steam would be inadequate to the maintenance of the motion when the vacuum had been destroyed. Thus the evil which began in a want of steam ended in a want of vacuum.

Is Nitrogen a Compound?—Mr. Reuben Phillips has just concluded a set of experiments which he believes to establish the fact that Nitrogen is not a simple body. These experiments are detailed in the November Number of *The Chemist*, and are preliminary to a more elaborate series, by which Mr. Phillips hopes to demonstrate the convertibility of nitrogen into carbonic oxide.

FROM OUR OWN CORRESPONDENTS.

GLASGOW.—*Dundyvan Iron Works.*—An extraordinary machine has been lately introduced here for expressing the impurities from the lumps of iron as they are taken from the puddling furnace, superseding the ordinary process of the forge-hammer. It cannot be better described than as a Brobdignagian coffee mill; the external cylindrical case, which may be about 4 feet in diameter, by 20 inches high, being grooved or fluted internally, in a direction parallel to the axis. The interior cylinder, which is grooved correspondingly, and driven by powerful machinery, is about 10 inches smaller in diameter, and placed so far eccentric in the case, as to admit a puddled ball of the usual size, which after undergoing rather unceremonious treatment, something between hugging, grinding, and devouring, is dismissed in the form of a cylinder from 4 to 5 inches in diameter, ready for the rolling mill. This is an American machine, patented by Mr. Laurence Hill, and erected by Mr. M'Onie of Glasgow. It is, we are given to understand, the only one in use in the kingdom.

Beale's Patent Lamp.—One of the various methods now in fashion, of doing the work of many little lights, by one great one, has been adopted with great success in Lancefield Foundry (Mr. Robert Napier's). The jet of flame is about 3 inches in diameter, and 15 to 18 inches high, burning with great clearness and brilliancy, and is, we think, peculiarly suitable to the requirements of the spacious and gloomy halls, where moulding operations on a great scale are carried on. The flame is urged by a blow pipe led from the fanner blast, and discharging immediately below the jet. The combustible employed is naphtha, at 4*d.* the gallon, which lasts about eight hours. When we consider that the light emitted is equal to that of from 30 to 50 candles, we are at a loss whether to admire more the convenience or the economy of the contrivance.

Fact for Andrew Smith.—We are informed that 16 tons of winding rope, in a superannuated condition, were lately removed from an inclined plane near Airdrie, after being 12 months in use. Six tons of the above were bought for the purpose of affording suitable employment in oakum picking for the inmates of a provincial jail in the neighbourhood.

Ejectment of a Moss.—Shortly since it was reported to the River Improvement Commission, that 160 acres of Blackstone Moss, 12 feet deep, were being floated down the river Cart into the Clyde, by the proprietor, one of those country gentlemen who delight in improving their estates, and who do what they can in a quiet way, to prevent either England or Glasgow from becoming "the workshop of the world." The expense of River improvements for the last year has been £100,000.

The British Queen.—The little British Queen that was sunk some weeks ago, in a severe gale, has since been raised at an expense of £20.

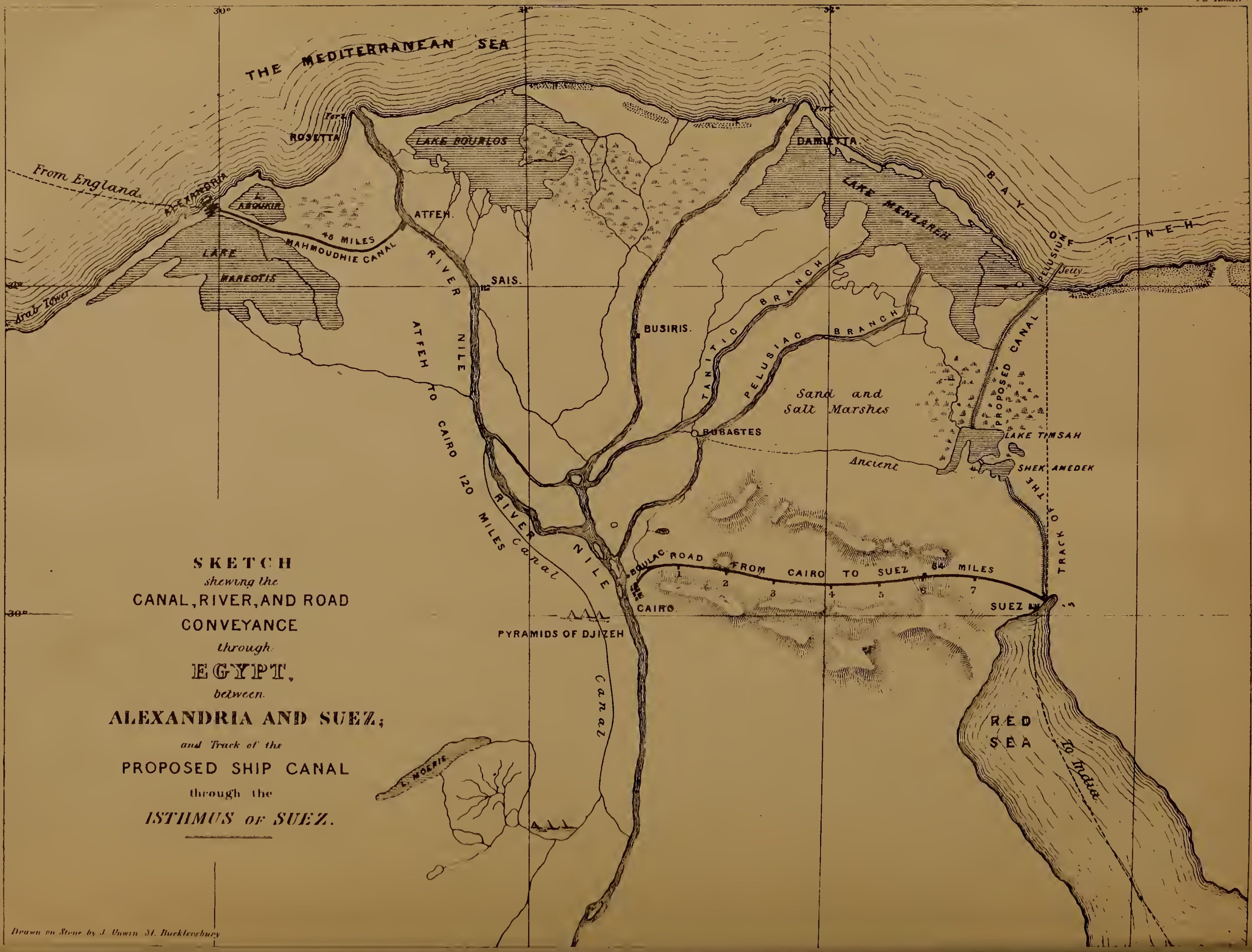
New 50 Ton Crane.—Messrs. Caird and Co. of Greenock, are constructing a new crane, warranted to lift 50 tons, for the south side of the Quay, near Springfield.

Feat of a Sailing Vessel.—A few weeks since one of the Leith clippers (Aberdeen built) performed the passage to the Nore in the astonishingly short period of 33 hours.

Glasgow and Garnkirk Railway.—A considerable length of the Glasgow and Garnkirk Railway has been re-laid with longitudinal timber baulks. The old form of rails and chains being continued.

New Cupola.—Yates's Patent Cupola with inclined alternating bridges, has been adopted to a considerable extent among the iron founders. Some saving of coke is found to take place, but the lodgement afforded by the bridges for the unburnt gases has repeatedly occasioned more or less serious explosions.

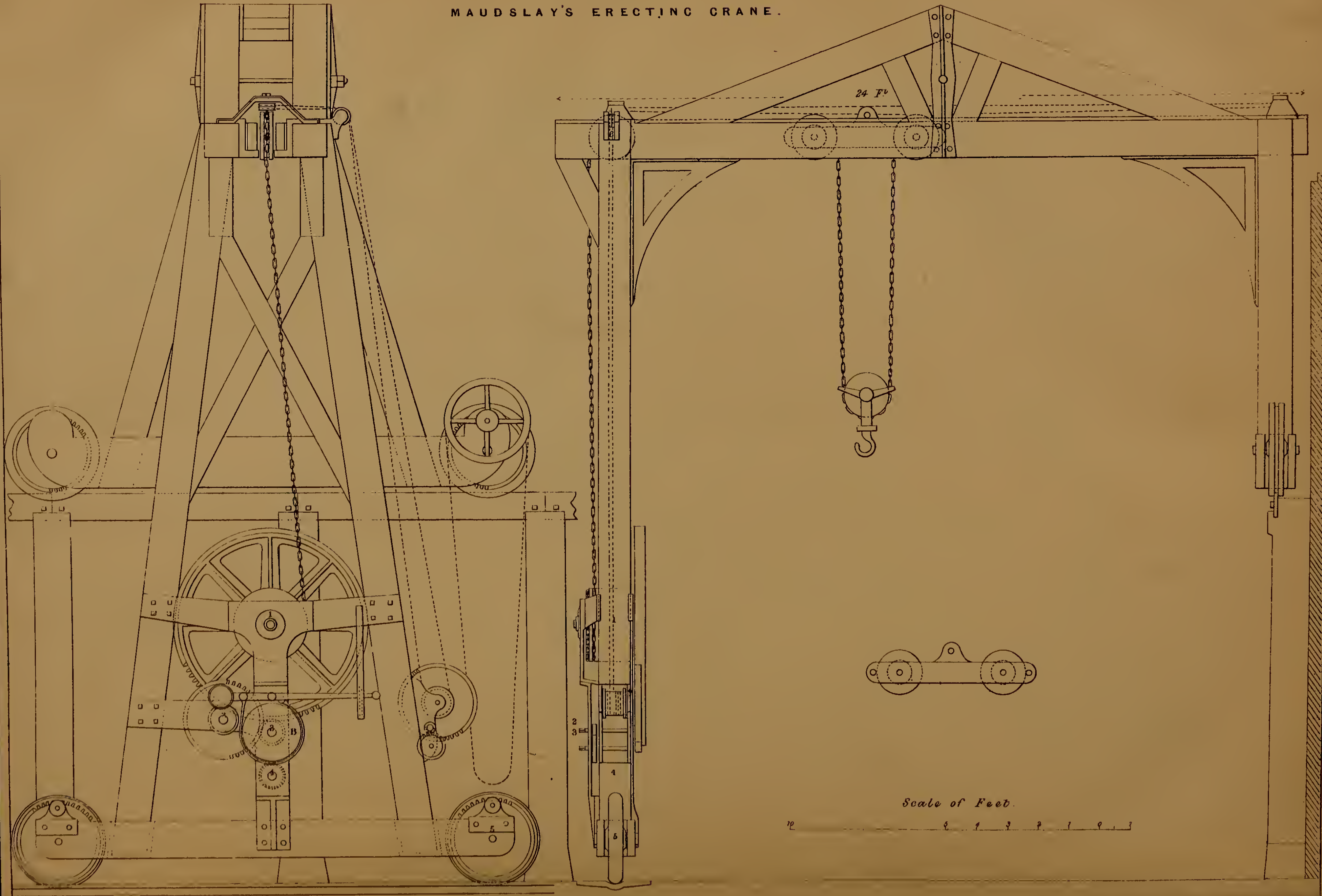
Luntley's Gas Burner.—We have been using to our great satisfaction, Luntley's Patent Smoke Consuming Argand Gas Burner. We think it gives a whiter light than any other household gas burner we at present remember to have seen.

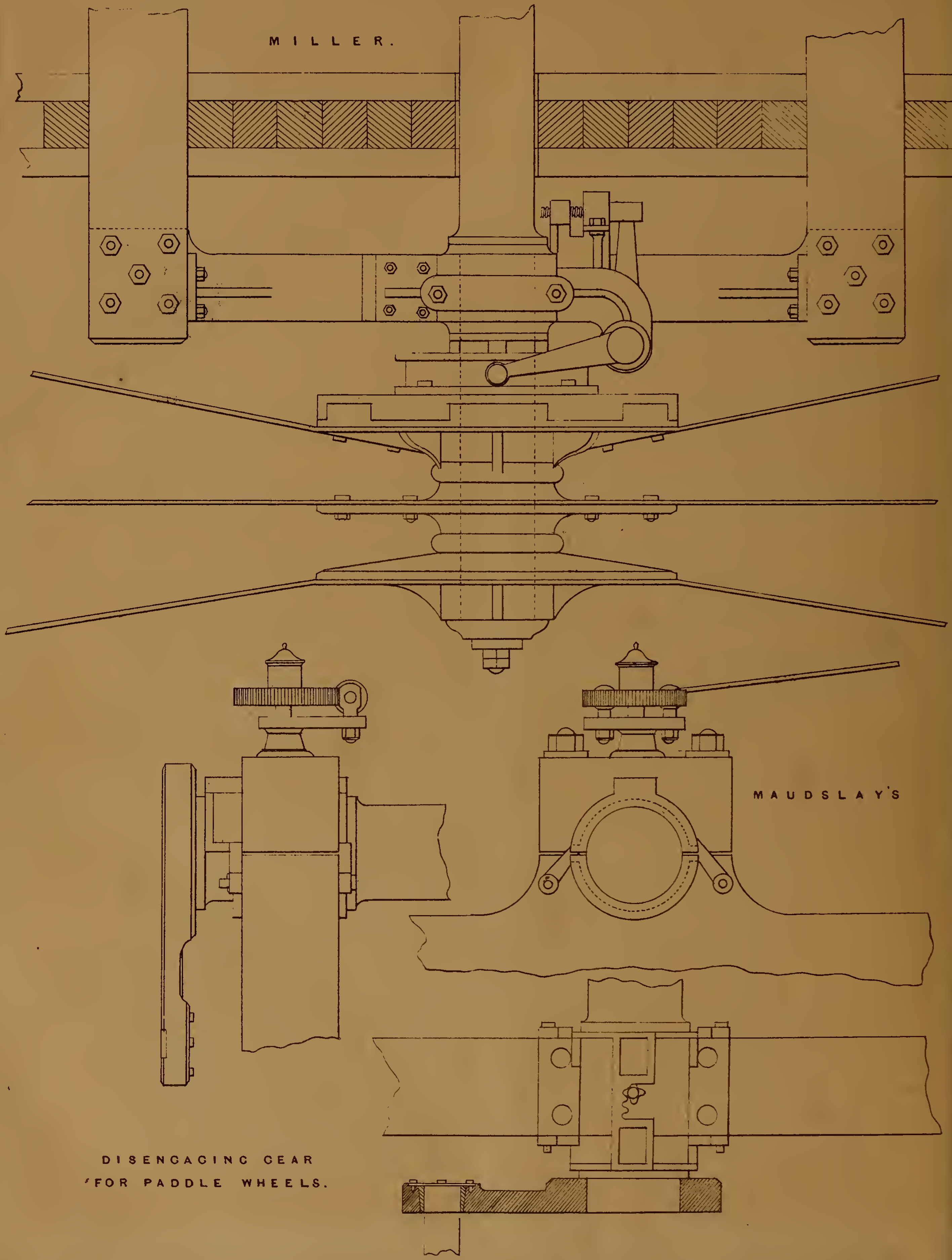


SKETCH
shewing the
CANAL, RIVER, AND ROAD
CONVEYANCE
through
EGYPT,
between
ALEXANDRIA AND SUEZ;
and Track of the
PROPOSED SHIP CANAL
through the
ISTHMUS OF SUEZ.

Drawn on Stone by J. Unwin 31. Bucklersbury

MAUDSLAY'S ERECTING CRANE.





DISENGAGING GEAR
FOR PADDLE WHEELS.

THE ARTIZAN.

No. XII.—DECEMBER 30th, 1843.

Art. I.—THE INFLUENCE OF GEOGRAPHICAL POSITION ON THE INTERCOURSE OF NATIONS.

Der Verkehr und die Ansied elungen dor Menschen in ihrer Abhängig keit Von der Gestaltung der Erdoberfläcke Von—(The Intercourse and the Settlements of Men in their Dependency on the Shape of the Earth's Surface. By) J. G. Kohl. Dresden: Arusld. 1841. 8vo.

The author of this book has achieved a great reputation by the honesty with which he has recorded the impressions made on his mind in the course of travels through Russia, Austria, and Ireland. That he has great powers of observation, and a faculty of reasoning from that which he may observe, more sure than is ordinarily found in company with such powers; that he has not travelled for the purpose of illustrating some particular theory of morals, or of defending some cherished system in politics; that having travelled, he yet has not found it incumbent on him, or thought it conducive to his renown, to promulgate new schemes for governing the conduct of individuals, or regulating the interdependency of classes; that his style is lively, flowing, and unambitious;—are all grounds of the favour with which the nations of Europe have greeted his works, and, in our humble judgment, resolve themselves into the master quality of his mind—integrity of understanding: a quality incompatible with mean powers, vulgar passions, and mere traditional prejudices. In seeking to account, however, for the combination of simplicity and aptness which distinguishes the travels of Mr. Kohl, considered as mere technical performances, we found that the quality of mind to which attention has been drawn was insufficient to afford the observer explanation. Men can no more use their eyes to effect without knowledge, than they can use their hands. What, then, the mind naturally asked, was the course of study that enabled this writer to seize at once on those features in the character of a people, and those principles in the institutions by which it is governed, that has been the determining cause of its past history, and of the political relations in which at this day it is involved?

The work before us is the answer. It is a mighty contribution to geographical and historical science, and, what in these times may be considered wonderful—it is new. For although, even in ancient works, that professed to describe countries and cities, something was always said concerning geographical position, the advantages of this or that site for the collection of masses of men, and the increase of a population once gathered together, and the obstacles or incentives to commerce presented by the physical boundaries and territorial properties of a country, a district, or town; yet heretofore these things have not been made the object and theme of special research and systematic treatment. This is the first experiment of the kind, the first attempt to throw light on a subject which is the basis of all political geography, and the foundation of historical and geographical science.

The author shows that the intercourse and the settlements of men, that is, the commerce of those who are distant, and the congregation on one spot of those who are near to one another, depend more or less on the shape of the earth's surface. The central lines of industry among civilized nations are the great navigable rivers; those, more especially, which receive the tributary waters of other rivers also navigable. Such rivers generally flow between two chains of mountains that throw out offshoots towards the stream, within which offshoots the smaller and tributary rivers have their source and bed. Such offshoots often form considerable mountain-chains, interrupted by rocky barriers and precipices, to rise again in less bold elevation, and, finally, to undulate gently towards the plain. In the midst of this labyrinth the water springs up, follows all its windings, and imitates the phases of its characters—now rushing downward in wild and foaming cataracts, now concentrating its power into a mighty volume that streams on with earnest majesty, summoning new and ever nobler forms of vegetable life to do homage to each stage of its course towards the favoured districts where beauty and fertility reign together. At last, when from either side the waters have reached the lowest part of the plain, they roll on in a common bed, seeking the bosom of the ocean, or some inland lake.

This relative position of mountain and river generally leads to two results: 1st, that the bed of the principal river is in the evenest and most fruitful soil; 2nd, that the course of the principal river generally lies midway between the sources of the tributary rivers. Those persons, therefore, who live on its banks, have the double advantage of a soil more fertile than that which lies nearer to the mountains, and of multiplied lines of communication that run from the centre to the circumference, and procure for them, both quickly and cheaply, the produce of distant provinces; but, further, almost all large rivers flow into the sea. Now the sea is the great highway of nations; the road which one people must take if it seeks intercourse, no matter of what character, with another that is at a distance. The whole industry of a nation, therefore, gravitates towards the sea; that is, towards the principal river of each district; so that the course of that river is the line by which every part of the district communicates with, and participates in, the general movement. Thus, not only those who dwell on the banks of the principal river, but those who have settled down by the streams that pay it tribute, find in the former the most advantageous means of communicating with the sea, and with one another. They therefore regard the whole of that river, from the point at which it becomes navigable, as common, indivisible, and inalienable property, the possession of which cannot be disturbed, physically or morally, that is, politically, without inflicting an injury, sometimes a fatal blow, on their industry. The free intercourse of nations is the essential condition of their advancement,—of their happiness.

By the bason of a river is understood the district watered by the principal river and the tributary streams, up to the ridge of the mountains which separate this net of waters from its neighbour. The bason of a river, therefore, composes an indivisible whole, whenever the river itself has become the central line of industry and mutual connection. From this, however, it does not follow, either that all great rivers are so circumstanced, or that the extent of the bason of a great river is the only circumstance that determines the extent of national territory, or the formation of kingdoms.

The sea is the great medium of communication between nations; means of reaching it, therefore, is the common aim of every people. If, then, we seek for the centres of the movement which follows on the formation of communities, on civilization, on national industry, on commerce, they will always be found at a spot that embraces the two following advantages—the easiest communication with the most numerous and most important districts of the national territory, the easiest communication with the sea, or with those seas that are nearest to the national territory. Such centres, when once they have attained to a certain degree of magnitude and splendour, become mighty springs wherewith impulse is given to the industry, and, generally, to the genius of a nation; they include a vast mass of interests within their periphery, and send, as from a focus, the rays of their influence in all directions and to great distances, with potential and unmistakable effect. Herein is couched the fundamental idea of that which is known in diplomacy as the rounding off of territory—*arrondir ses états* is the governing principle of Prussian policy; the bringing the whole territory, as it were, within a ring-fence.

The influence of these geographical, political centres, and the necessity of all people for communication with the sea, will explain, 1st. Why it is that the nations which have settled in the bason of a great river generally rule over the narrow strips of coast that run parallel with it and separate it from the sea. 2nd. Why it is that several small basons, the aggregate of which is bounded by a high chain of mountains or the sea, fall under the influence of a common centre, and compose, politically, one territory. 3rd. Why even several large basons, that, taken together, lie between more seas than one, but are not separated by great physical impediments, nay, are easily brought into connexion, obey a common influence. 4th. Why large rivers, even when very great, are oftener more fitted for boundaries than for central lines, either because they have few navigable tributaries, or that an unequal distribution of the lesser streams has formed a bason so irregular and unpropitious of shape, that it becomes difficult to form a centre which shall command all parts of the bason, and counterbalance the influence of a neighbouring centre that is more happily situated. 5th. Why straits and channels that are long, and therein, like rivers, follow the same laws, and are either central or boundary lines according as they are used to overrule great and permanent interests, or merely afford a passage between regions, each of which submits to a distinct centre. 6th. Why, now and then, the same river, at different parts of its course, is a boundary line or a central line.

Great rivers are the centre lines of industry and commerce so long only as they are navigable, and flow through a soil that is susceptible of cultivation.

In the grand and solemn recesses of the mountain region that is their birthplace, amid the maze of boulders and precipices, of soaring pinnacles and abrupt clefts, of torrents and ravines, the waters that roll forth in every direction and with ever-accumulating volume towards the sea, are not for commerce. On the other hand, the customs of Alpine life, and the peculiarity of character that distinguishes the children of the mountain, create a community of wants and sympathies which binds men together by clamps more strong and enduring than are any interests which can pertain to rivers, as yet insignificant. It is not until after it has emerged from the secondary chain which surrounds the loftiest ridges of the mountains whence it springs, that a river becomes important. The middle and highest portions of the central chain in any quarter of the globe, the Alps, in whatever latitude they may be, invariably constitute a region to which a peculiar political character belongs. The principle of that peculiarity, no matter what the outward form, is freedom; for, to subdue nature when it wars with him, man must be free.

The work of Mr. Kohl is divided into eighteen chapters, under the following headings: Introduction and Plan; The Surface of the Earth, considered as the Correlative of Intercourse; The Figure of the Superficial Phases of the Earth, and their Effect on Intercourse; Settlement; The Inequalities of the Earth's Surface; Islands and Continents; Oceans and Inland Seas; Peninsulas and Bays; Straits and Isthmuses; Certain other Antitheses; The Influence of Moral Relations on Intercourse and Settlement; The Influence of the Produce of the Soil on the Concentration of Intercourse and Population; The Changes of the Earth's Surface during the Period of History; Concluding Remarks.

The causes of the unequal distribution of population over the surface of the earth are partly moral or political, partly physical,

The moral or political causes of the varying density of population, are founded on the state of civilization, and especially on the political constitution of the inhabitants of different countries. A people of hunters requires larger tracts of country than one of shepherds; the latter larger tracts than a people which tills the soil; and this last larger tracts than a nation of manufacturers. In a state that is well regulated, politically and municipally, the population is better off, and therefore increases faster, than in a state which anarchy preys on.

The manners too, and habits of a people, have considerable influence on the density of its population. The physical causes of the concentration of population are partly the richness of the soil, partly the form of the earth's surface. The relative positions of land and water, of mountain and plain, and the other peculiarities of a given region, produce the condensation or diffusion of its inhabitants, according as they tend to further or hinder intercourse. To Mr. Kohl belongs the merit of the first attempt to trace the development and final effect of these latter causes on the mutual intercourse of nations, and the choice of settlement by a given people.

He begins by considering the intercourse of nations, the form of the earth's surface, and the circumstances that determine the choice of particular localities for permanent abode. Having thereby elucidated certain general propositions, he proceeds to apply them, according to a previous classification, to the different superficial variations of the earth. Now there is no antithesis on the earth's surface so striking as that between high lands and low lands; for on it depend, not only the obvious boundaries of land and water, but the superficial properties of almost any pair of superficial opposites that can be named. The practical part of the work, therefore, commences with a consideration of mountains, valleys, and plains. A more important but less striking contrast is exhibited between land and water; and to this theme the greater part of the practical considerations is devoted. The chapters on the influence of moral and political relations, and of the produce of the soil on intercourse and settlement; and the chapter on the changes of the earth's surface during the period of history, are in the nature of an appendix to those which precede them. We have not, however, space for following the author into the details of his book; and having given a general notion of its contents, prefer to draw attention towards the matters which are treated in the concluding chapters.

Mr. Kohl shows, in the course of his work, the dependency of man on nature; and of his intercourse with his fellow men in the forms of the earth's surface: he explains, further, how it is that the very settlements which are necessary if intercourse is to exist, or desirable if it is to be extended, are called into existence by the superficial properties and peculiarities of a given territory. Man, however, is not altogether the slave of nature; in many respects he is his own and her master. Nature and man, necessity and freewill, climate and moral circumstances, all combined, have produced those phenomena which the human race exhibits.

The author says: "Chance, arbitary power, whim, a happy thought, wind and weather, fate and natural propensities, shape, in their multifarious action and reaction, as well the general relations of mankind, as those particular relations that determine the intercourse of men and the building of cities. With regard to the influence which man exercises immediately or mediately, on the building of cities, or on intercourse generally, it is to be observed, in the first place, that such influence is far less enduring than that of nature. For man, in one century, is civil, industrious, and bustling; in another, rude, barbarous, and intractable; now assuming this custom, now adopting that; and ever passing beyond ancient limits, is far more changeable than nature, which for thousands of years has transmitted its waters through the same beds; now, as of old, embraces the same forms of land with the same arms of the sea; still towers up the same masses of mountains to the firmament; and ever works silently and slowly, but surely, equably, constantly, and continuously. Conquerors spread their greedy hands over vast tracts of territory,—careless of natural boundaries, and of all that fine web and tissue in the sequency of events, the threads of which we have sought after,—roll up together, and pile up upon one another, just as to them seems meet. Old cities are rooted up, and new are built, as the humour of the potentate directs. New roads are constructed at the command of the mighty one, and the old are abandoned, just as chance will have it. A wall of privilege is erected, more potent, for a time, than any stream; a line of tolls is established, as impassable a barrier, for a time also, as any ridge of mountains. Seas seem to be no impediments; the regions of ice and the regions of sand, alike are traversed; the river-gods are thrown into chains; the nymphs are hunted from their forests.

"The masses which political influence sets in motion spring up like torrents from their beds, rush over the fields, throw down all natural landmarks, confound lake and pool and rill; so that, in contemplating their violence, it might almost appear but fruitless trouble to grope after the boundaries which nature makes, were it not that those political events which imitate the incursions of swollen streams, like to them, must subside into the natural channel without making any essential or permanent change of circumstances. The same hill-tops peer forth again from the flood; the waters are again collected into the same lakes and pools; the streamlets and rills are calmed, and flow within the old banks; and all things fall back to their ancient quarters, and keep within their wonted bounds."

The political or moral causes that have influence on the intercourse of men are obviously of two kinds; either they spring from the properties of the soil, or are founded on the character of the inhabitants, such as nature fashioned it; or as it has been moulded by the influence of great men, of powerful neighbours, or of conquerors, whether fiercely resisted or abjectly served. Let us consider each of these classes.

The action of those political causes which have their origin in the nature and properties of the soil, appears to be subsidiary to the action of the physical causes; for it will always be found that a physical impediment to intercourse and commerce produces in the national mind an indisposition to intercourse and commerce; while, on the other hand, whenever the water-power is great, or, in some other fashion, the surface of the country is propitious to intercommunication, the popular mind acquires both a love of intercourse and commerce, and an aptness for them. Man lives in the air, treads the ground, and can pass by water from place to place. Whatever influence, then, nature exercises on his moral condition, must be derived from the properties of the air which he breathes, or the peculiarities of the soil which he treads on, or the mode in which he is able to use the water that is within his reach as a moving power. Of the physical influences that determine the character and peculiarities of a nation, those which depend on the properties of the air are by far the most important. Many effects of which the soil is the primal cause are felt by means of the air only, and in practice are considered as immediate effects of the air, and but mediately as effects of the soil. Land and water, with all that has action on them; the electricity that streams forth from the soil; magnetism; the vapours of the waters and the forests; the clouds that ascend from earth towards heaven; the mountains that seek, as it were, a purer atmosphere; the light of the sun and the stars; produce the effects that become sensible or palpable to our restricted organization, by means of the air, the atmosphere. In practice, the distinction between cosmic and telluric influence is lost sight of; and the collective effects of the atmosphere, no matter how caused, on the condition of man in a given region, are comprehended under the term climate.

The influence of the sun in determining and moulding the physical condition of man is infinite and manifold. For the purposes of this paper it may be considered as twofold, according as it developes warmth or communicates light. Light and warmth are the most important, as they are the mightiest forces that issue from this planet, and operate on the soul and body of man; the distribution of them therefore is a matter of incalculable moment. It depends on the relative position of the earth to the sun, on the curvature of the earth's surface, and on the situation of a given spot with reference to this curvature, or, in other words, on its geographical position. Now, as a general proposition, light and warmth increase from the poles towards the equator, so that the earth may be said to be surrounded by a series of rings or zones, within each of which the distribution of light and development of heat is equable. This leads the mind at once to infer a stratification of moral powers corresponding to these zones, perpendicular to the poles and parallel to the equator, and to conclude that in advancing from the pole to the equator the traveller will observe a continuous variation of character, and that in making a circuit of the earth constantly equidistant from the pole and the equator, he will perceive a similarity of manners and character, so far as either is under the influence of light and heat. The consequence of this is, that the advancement of commerce and intercourse from north to south, by reason of the differences in manners, character, and national elements, is opposed by far greater hinderances than their extension has to encounter when they are pushed from east to west, that is, in the same zone in which like ever meets with like.

The soil produces its influence on man, either immediately, or mediately through the atmosphere. Immediately, partly by the degree of its fertility, partly by the form of its surface. In the desert we find only robbers, and the nomad tribes. The mediate influence of the soil is altogether atmospheric. The soil is in some respects dependent on the atmosphere; it is more or less fertilized by the fructifying matter which the air deposits; it is moistened by its humours, parched up by its dryness, and in like manner varies with the changes of its constitution. On the other hand, the atmosphere is dependent on the soil, it receives moisture and vapour, by the soil it is rendered dry; and thus soil and atmosphere, by their action and reaction, determine the condition of climate. With regard to the atmospheric changes that depend on the chemical properties of the soil, this much may be affirmed generally; a difference in the constituent elements of the surface or crust will produce a corresponding difference in the atmosphere, which will have its proper effect on man. Too nice an inquiry would it be to search after the effect on the atmosphere and man of the vapours that are peculiar to a clay soil,—to determine the qualities of mind that are furthered by a sandy soil,—and to track the influence of the miasmata of the marsh. We may observe, however, that the vapours of marshes have an injurious effect on the character and constitution of man, render him sickly and inefficient, and produce a feeble race, as in the Volhynian and Pontine marshes. In marshy districts, therefore, the bad air and the inferior race combine to render the existence of a traveller uncomfortable, and so to check commerce. The consequence is, that such districts are barbarous. The case of vast forests is similar. The industry of those who dwell in them is generally of a rough and coarse kind, that requires little art or science. The air is raw, the climate wild, agriculture difficult. The rays of the sun can scarcely penetrate, and even as the ice and the cold of winter abide longer therein, the frost and chill of the mind are more slow to yield. To the physical influences of the forest, there is associated a moral savageness that operates as a barrier to intercourse. The want of trees produces an unculture of another kind. Some trees there must be, or cultivation becomes impossible; besides that, the soil needs some shade. Thus, those regions that are only covered with a wild vegetation of grass and weed, and underwood, are unpropitious to agriculture, and are the dwelling places of nomadic tribes, like the steppes of Asia, and the pampas of South America. Mountains, on the other hand, are, as already we have observed, favourable to freedom, and to the development of the nobler qualities. The purity of the air imparts liveliness to the mind, gives the frame an inward elasticity that prompts to bodily exercise, and that familiarity with physical danger that makes men brave and self-relying. The peculiarities of the soil make men brothers, or, in another word, patriots. Towards this, the pictorial beauties of the country contribute much. He who has once beheld the far-reaching prospects, the massive and lofty heights, the exquisitely beautiful valleys, and, above all, the wondrous charms of colour, proper to Alpine scenery, will easily understand, that a man who has passed his infancy therein regards it as a region with which none other can be compared, and feels himself nowhere else at home.

There are, however, powers of mind, talents, peculiarities of character, which neither soil, nor atmosphere, nor climate give to a people. The might of the soil, of the air, of the climate is great; zone, and mountain, and marsh, and sand, and forest, and wilderness, each seeks to mould, and form after one model, the character of those who dwell within the range of its dominion; but the character which nature has given to a race, or which a race by means of education has given to itself, has rights that nature cannot overcome, powers to which nature must yield. Thus two classes of moral influences, co-ordinate and co-existent, yet neither neutralizing the other, determine the manners, the habits, the disposition, the genius of a people. There is something in man, given him, or acquired by him, which he does not receive from the soil that gives him birth, which he takes with him to every soil that gives him nourishment, which he has received from his fathers, which he trausmits to his children, which is and ever remains the enduring, imperishable heritage of his race. Most difficult is it, however, in considering all the manifestations of moral power, moral inclination, moral reason, and moral incapacity, that make up national character, to distinguish between the phenomena that spring from original organization, and the results of an artificial modification consequent on a violent change of manners and customs, or a slow but comprehensive reconstitution of the elements of opinion. For the effect of education may be, either to strengthen and develope that which is natural, or to substitute for it that which is artificial; and in both cases the result will be similar, so far as uniformity of transmission is concerned. More to our purpose will it be to pursue the inquiry which is suggested by the classification adopted by Mr. Kohl, who divides the moral impulses that have influence on the condition of man, into those which proceed from the governing power, and those which are communicated from other sources. No other moral power is so strong and binding, none can so effectively control the social movement, none consequently can oppose such barriers to intercourse, as the supreme power in the state. To the influence of this power only can we attribute those singular and apparently capricious departures from the plan which nature suggests, that are occasionally to be observed. It is sometimes consistent with the policy of a dynasty, or of a faction, to build cities and construct channels of communication inconsistent with the natural opportunities and obvious interest of the people over which it rules; at other times the peculiarity of national sentiment, such as the hatred of neighbours, or the desire to preserve a political independence to which the nature of a given territory is unpropitious, will force even a wise and paternal government to neglect natural advantages, and to cultivate an artificial system, that can only be reconciled with the delusive and ideal good that has seized on the popular mind. In either case, the influence is communicated by the supreme power in the state, and produces an almost immeasurable effect on intercourse and settlements.

Some states are so unwisely regulated, have such bad laws, such corrupt tribunals, keep up such bad roads, and afford so little security against robbers and knaves, that the influence which their existences exerts on commerce, is pretty much like that which is produced by a morass, or a wilderness, or any other unfavourable or impassable region. On the other hand, there are states that have such wise laws, such just judges, such well-disposed citizens, such good roads, such well served post-offices, and altogether such admirable institutions, that their territory, like the sea, promotes and extends commerce. If two states, so differing, are neighbours, the consequences are similar to those which follow on the alternation of continent and sea, of fertile and sterile districts within the same country. The alternation of countries is not without influence. Though one state be as well organized as the other, yet trade, when it passes the boundary, becomes subject to other laws, customs, and wants, and therefore also to influences differing from those under which it theretofore has flourished. Then again, there are such institutions as custom-houses, such principles as that of protection, such wants as that of revenue, in and by which commerce is made to feel the power of the supreme authority in the different countries over which it ranges. Lastly, we may observe that the government of each country exercises an incalculable influence on the intercourse that takes place between different portions of its own dominions, as the history of our own colonies satisfactorily proves.

It would not be difficult to construct a table of the influences which the supreme power in a state exercises on the direction and extent of commerce, and on the mode in which its territory is inhabited. Far from easy, on the other hand, is it to follow the operation of those moral causes which do not proceed from the supreme power,—of manners and customs, of inventions, of certain talents and aptitudes, of propensities and aversions, and the like. The result, however, may be thus stated; the natural influence of the form of the soil is limited, restricted, and modified by the political and moral influences that regulate the industry, and determine the character of the inhabitants; but they are only limited, restricted, and modified; they are neither overthrown nor permanently changed by the latter. It will always be found, therefore, that intercourse within, commerce without, and settlements in a particular country have been produced by, and depend on the form of its surface, subject always to the modification which moral influences have been able to effect.

The influence of natural products, of the animal, vegetable, and mineral kingdoms, has been briefly considered by Mr. Kohl. The inorganic constituents of the earth's surface are of variable value to man; they are moreover unequally distributed, and in groups they are all more or less difficult and expensive to obtain; and force those who seek them in the bowels of the earth to erect establishments more or less costly. As a general rule it may be laid down, that in proportion as the product sought is in itself valuable, as the mode of procuring it is difficult and expensive; and as its concentration in masses on particular spots is determinate, it will give rise to great and permanent settlements.

The animals which the hunter pursues are scattered over wide districts, and often change their coverts, so that he is not easily domiciled. The cultivation of the plants that root in the soil, and serve as nourishment for man or animals, forces the cultivator to abide in one place, and so leads to association and settlement. Much skill, many arts and inventions, are necessary to the miner. In the vegetable kingdom, nature offers her gifts prepared for the use of man: the timber is employed in building, the fruits for nourishment, and the leaves, stalks, and fibres are easily converted into clothing. More easy, again, is it to turn animals to a desired useful purpose. While the more important and the larger number of plants require care at the hands of man, animals, alone, in the fields and forests, without assistance, without education, arrive at perfection. So also the materials of which animals are composed are easily converted to use. Animals, like men, follow the plants and springs that afford them sustenance. Fertile pastures, vallies of rivers, springs, and streamlets, will be the gathering places of both men and animals, who, in this respect, are dependent on the same conditions and influences. But man is the most fickle being on the earth. The political structures, therefore, that rest on this fickleness, as on a basis, are subject to the greatest revolutions and transformations. A mighty power rises up, even as the clouds that herald a storm accumulate, is formed, is destroyed, and all with such velocity, that before men have time to determine its origin, or comprehend its nature, it has gone through the several stages of birth, maturity, and dissolution. Cities are built and overthrown, constitutions are created and swallowed up, or impregnated by foreign elements that further new births to light; and so the human mind seethes and bubbles, ever rich, nay inexhaustible, in new thoughts, in forms and creations unheard of.

Nature, on the other hand, which would appear to have effected at one time revolutions and transformations similar to those which now are the work of man, to have furrowed the whole surface of the earth in the wildness of its movements and the might of its operations, to have indeed given birth, and in awful throes, to a race of Titans, whose monuments lie strewn from pole to pole—nature, since man has appeared, and, perhaps in order that he might appear and be, has pursued a course of regulated and equable action. Its structures stand on stable foundations,—its roots spread deep and wide,—its waters have gathered into restricted limits, and know their bounds. The chaotic confusion of solids and fluids exists but on few spots. The mountains that have reared themselves up, now dry and cold, have ceased to waver and bend, and are transformed into solid and eternal masses of pyramid and column. Vallies have been graven into the surface, and prescribe a course to the rivers, which flow on constantly and immutably. The winds, like the waters, have their proper channels, less confined indeed, but within which they too must flow with the like regularity. Those ancient and firm shapings of the earth's surface, mid which the streams of commerce and political events roll on, as though man thought not of them, or dreamed of subduing them, are not, however, so obdurate and unyielding, as never to retire before or comply with the necessities of intercourse. Neither, albeit in their fundamental forms and elemental condition immutable, are they so unalterably constant, as never to undergo change. New chains of mountains no longer rise from the lap of the earth; the crust of the earth is not indented anew by vast fissures and clefts, and abysmal hollows; new rivers, new systems of rivers no longer spin their meshes; the sea no longer engulfs whole countries, large islands, nay parts of continents; nay, even new channels of the sea are no longer opened, new isthmuses are no longer battered out of the firm earth. Yet, on a small scale such changes and transformations still take place: they have often taken place during the period of history, and therefore are not without some influence on the intercourse of men.

Thus has the writer of this paper brought to a close an account of this work of Mr. Kohl; a work that has opened new themes of inquiry, a new region of thought, to the reflecting mind; a work for which the author deserves the thanks of all who take an interest in history and geography; a work which, it is unhesitatingly predicted, is destined to become classical in the languages of the civilized world.

Art. II.—GREAT WATER-WHEEL AT GREENOCK.

Specification of Water-Wheel for the Shaw's Water Cotton-spinning Company, Greenock.

The wheel to be 64ft. diameter over shrouds; the depth of shrouds 1ft. 4in.; metal in shroud 1in. thick in centre, and a belt of 2in. deep upon top and bottom of shroud to be 1½in. thick; width within shrouds to be 12ft.; diameter of toothed segments 61ft. 3½in., and 3½in. pitch; breadth of cog 1ft. 3in.

The wheel to contain 32 shrouds, 32 toothed segments, 32 malleable iron arms, and the same number of diagonal stays, 2½in. diameter, made of Lowmoor iron, the ends of which are to be of the best scrap iron, 4in. square where they enter the centres, and to the depth of 15in., with slits for cutters 6in. by 1½in.

The wheel to contain 160 buckets, and the opening at mouth to be 6in.; sole and buckets to be of the best Staffordshire iron, No. 10 wire gauge; the rivets for sole to be ⅝ of an inch diameter, and 2½in. apart. The sole must be completely water-tight, and guaranteed that no water shall escape when the whole weight of water is on the wheel, either at the joinings of plates on sole, or at the arms or diagonal ends. Rivets for buckets to be the same as those for sole, and 4½in. apart; the buckets to be riveted, and bent to sole without angled iron; buckets to have five stays in width of wheel, each stay ¾in. diameter, riveted with a ruff and washer on one end, and two nuts on the other.

The journals of axle to be 15in. diameter, and 20in. long, to be made to run in cast-iron (instead of brass) bushes, and the axle to weigh not less than 7 tons. Centres not to be less than 10ft. diameter, and weighing 3½ tons each at least, and to be hung with eight keys, not less than 2¾in. by 2¼in. The shrouds, where they receive the arms and diagonal stays, to have a gradual swell of 9in. on side of centre of arm, &c. The cistern to be 10ft. broad, 36ft. long, 3ft. deep, and metal ½in. thick, and properly stiffened with bars cast on sides.

The governor to be constructed upon the newest and most improved plan; to be placed in the most convenient situation for working, and to be so prepared to act, along with a break of sufficient power and strength, as to equalize effectually the speed or motion of the wheel. The governor and break to be constructed by the maker on the plan he considers best adapted for a wheel of this magnitude.

The plates, pillow-blocks, pedestals, belts, cutters, &c., &c., and all fastenings, to be of the strongest and best description, sufficient for a wheel of the power of 120 horses. The workmanship to be of the most accurate and substantial description, and all the bearings and joinings to be fitted metal to metal in a first-rate style of workmanship.

The bolts for fixing the plates under main axle and spur-wheels, to be 22ft. long by 2in. diameter, and screws 2½in. diameter. The cast-iron plate under spur-wheels and axle to be cast so as to have all the bearings resting thereon, and binding together the first cross shaft, the first lying shaft, and pillow-blocks of main axle. The first cross-shaft from water-wheel to be made, as shown in drawings, full size; the pinion to be 6ft. diameter, and the wheel on the other end to be 18ft. 2½in. in diameter, with a pitch of 3½in. First lying-shaft to be the same length and size as shown in drawings; pinion on this shaft 5ft. 6in. diameter; breadth of cog 1ft. 3in.

Whatever alterations are made from this specification, as regards the strength or size of materials, must be agreed to in writing by the Company or their manager; and should any alterations be made from this specification, the additions or deductions occasioned thereby to be adjusted by the nearest corresponding prices that can be ascertained; and in the event of any dispute arising between the parties, the difference to be referred to the decision of two arbiters, mutually chosen, with power to them to choose an oversman in case of their differing, whose decision shall in all cases be binding on both parties.

The contractor to finish the work all in the first style of workmanship, and to guarantee the wheel and gearing in all their departments as a strong and substantial work, and capable of acting in a satisfactory manner for the period of seven years from the date of their being started, or for two years after the whole weight of machinery is put upon the wheel; and should the wheel or gearing, or any part connected therewith, that has been fitted up by the contractor, give way or fail in any part before the expiry of the period mentioned, that the contractor shall indemnify the Company in all loss or damage they may sustain during the period their works may be standing idle in consequence of the insufficiency of the workmanship or materials put into the wheel and gearing, or any part connected therewith and fitted up by the contractor;—the damage or loss occasioned thereby to be ascertained by two arbiters mutually chosen, with the same power as formerly mentioned: and the contractors further binding themselves to put to rights, repair, or renew whatever may be deficient or wrong, either in the materials or workmanship put into the wheel or gearing, or any part connected therewith, as formerly stated; and that free of all charge or cost against the Company.

The wheel and gearing, &c., &c., to be completed by a time specified, and ready for starting, and in every respect finished. The contractors bind themselves, should the wheel and great gearing not be completely finished and ready for starting by the time specified, they will pay or forfeit to the Company the sum of twenty-five pounds sterling each week thereafter, and that until the same is started in complete working order.

The price to include wheel, gearing, shafting, governor, break cistern, cistern supports, shuttles, pinions, rack, winding apparatus, pillow-blocks, plates, bolts, &c., and every requisite for a complete and substantial work, such as is required and usual in works of a similar description; and all to be delivered and fitted up at the Company's works on the Shaw's Water, Greenock, for the sum stated in the estimate.

One half of the price of wheel and gearing will be paid when delivered on the Company's ground, and the other half when started to their entire satisfaction.

[This wheel was made at Deanstone, under the direction of Mr. Smith, for the sum of 2,300*l.* Its operation, we understand, has been highly satisfactory.]

Art. III.—THE POLARIZATION OF LIGHT.

Lectures on Polarized Light, delivered before the Pharmaceutical Society of Great Britain. London: Longman and Co. 1843.

Soon after the phenomena of polarized light began to attract attention, we remember attending a lecture on the subject, wherein the lecturer undertook to explain to his auditory the nature of that newly-discovered property of light. To render the explanation more clear, he was provided with an apparatus constructed of card-board; one part of which resembled, if we may be allowed the comparison, a common gridiron; the other, a many-pronged fork. The fork, when presented to the gridiron with its card edges directed longitudinally, passed through the bars; but when presented to it transversely, of course its progress was obstructed. The lecturer, with many flourishes of his elegant implements, first passed the prongs of the fork through the bars, telling his audience that exemplified such an operation—the transmission of natural light; and then bringing the fork and the gridiron to the position in which the prongs would not pass, he exclaimed, in a tone of no slight exultation, "and this, ladies and gentlemen, is polarized light."

An illustration thus simple, of phenomena so numerous and extraordinary, was scarcely so satisfactory to the larger proportion of the audience as the lecturer evidently deemed it ought to have been; nevertheless, those who were inquisitive enough to desire a further explanation, might have searched long and far without meeting with any greater measure of knowledge. In proportion to the complication and obscurity of the phenomena of polarized light, was the inveteracy of the mystification and dogmatism of those who undertook to instruct the world on the subject. Experiments were indistinctly narrated, extraordinary results announced; and the reader, or listener, told that such an effect was produced by 727 millions of millions of vibrations in a second; and that another, more brilliant, by the smaller number of 535 millions of millions of vibrations in the same space of time. He was told of these vibrations being first in one plane, and then in another; and if he was anxious to arrive at the cause of these wonders, and to have more satisfactory evidence than mere assertion, the before-mentioned gridiron and fork, or some other equally elegant apparatus, was paraded, with the assurance that "this, ladies and gentlemen, is polarized light."

M. Arago, who is usually remarkably lucid in all he undertakes to explain, failed in endeavouring to convey to the uninitiated some notion of what really is meant by the polarization of light, and how the effects are produced. The difficulty no doubt arises, in a great measure, from the complexity of the subject, aided, in many cases, in no small degree, by the anxiety of the expounders to enforce some peculiar notions of their own, to which the main object is made to give way. The work before us is more free from these defects than any we have seen. The lecturer, indeed, occasionally flourishes the gridiron, but he does not content himself with that manipulation. He mentions the effects of what is termed polarized light, and he explains, without obscurity, the received theories by which those effects are accounted for, without having many crotchets of his own to impose upon us. He further attempts to show that a knowledge of polarized light might be of great practical use in numerous cases which have resisted more tangible agents; and he may observe that it is no bad sign of the sense of the present generation, that the professors of every science seem to consider the uses to which it may be applied as a test of its importance, and strive, consequently, to connect it in some way or other with the interests of society. It may surprise those who have, perhaps, only regarded the polarization of light as one of the curiosities of science, to learn that it is available, according to this lecturer, for the detection of the adulteration of foods, drugs, and chemicals; for determining the commercial value of saccharine juices; and the nature of the changes which occur in certain chemical and vital processes in which ordinary chemical analysis completely fails; for detecting the existence of diseases, and for avoiding shoals and rocks at sea!

Such being the *possible* appliances of which polarized light is capable, it may be as well, now that we have at hand the assistance of this able expounder, to attempt to convey to those of our readers who may have but an indistinct notion of the subject, what is the meaning of the "polarization of light;" the more especially, as our lecturer himself admits that it has often puzzled philosophers to answer the question. In the first place, then, let us reject all idea of *polarization;* with which the phenomena of what is called polarized light, as at present understood, have no connexion whatever. It is to this misapplication of a name that the mistaken notion on the subject may in a great measure be attributed. The explanation depends entirely on the wave theory of light. Each ray of natural light is supposed to consist of two waves of the luminiferous ether, which waves vibrate at right angles to each other. It is assumed that this compound ray of light, on being reflected from or transmitted through various substances, becomes separated into its two component parts; and, when thus separated, the ray is said to be *polarized.* Each of these separated rays possesses similar physical properties, and may be further decomposed into the prismatic colours. To the unassisted eye the single ray appears in all respects, except in brilliancy, the same as the double one. The most easily observed difference between the two is this, that certain transparent media, when held in certain positions, refuse passage to this light. (Here comes the gridiron.) When, for example, a ray of light reflected obliquely from a mahogany table, is looked at through a thin piece of tourmalin, or through a number of pieces of window-glass laid upon one another, the ray will be visible or invisible according to the position in which the tourmalin or bundle of glass is held, though other objects looked at through the tourmalin, will be visible in all its positions. The cause why other objects are seen when the ray from the table is invisible, is, that as the natural rays consist of vibrations of both kinds, some of them will pass through the tourmalin in all its positions; but the ray from the table being polarized or separated, will only pass, in certain directions, through substances capable of polarizing or separating compound rays. If the ray of natural light first pass through the tourmalin, it undergoes separation in the same manner as by the reflection from the table; and when looked at through a second piece of tourmalin, would be found to possess the same properties as the reflected ray. In what manner tourmalin, or any other polarizer or separater, acts on the rays of light to produce this effect, is not actually known, though it would appear, from the dogmatical manner in which the phenomena are sometimes explained, that the whole mystery of light had been laid bare to those philosophers. We have no intention to follow their example, nor at present to enter more at large into these curious and interesting properties of light. The publication of a course of lectures on this subject, less obscure than usual, has induced us to call the attention of our readers to the work before us, and to explain the meaning of a term often spoken of, and but little comprehended. If we have removed any of the darkness in which the subject is involved, it is well; if not, we have at least done as much as many others before us, and in less space,—we have flourished our gridiron, and announced, "this, ladies and gentlemen, is polarized light!"

Art. IV.—GEOLOGY APPLIED TO AGRICULTURE.

The Application of Geology to Agriculture, and to the Improvement and Valuation of Land. By Nicholas Whitley, Land-surveyor. London: Longman. 1843.

Our landowners and farmers being threatened with the free competition of produce from foreign and more genial climes, do well to look about for aid to all quarters whence they may gain assistance. Chemistry and physiology have been for some time applied to increase the yield of the soil, and to improve the breed of live stock, and now comes geology, from the innermost parts of the earth, to the succour of English agriculture. It must be said, indeed, of geology, that it has lately been evincing in other directions a desire to be more practically useful, and to disabuse people of the rather prevalent idea that it is a merely speculative science, the chief object of which is to ascertain whether the earth was manufactured by ice, by fire, or by water. In the work before us, Mr. Whitley endeavours to show that the fertility of the land depends principally on the character of the rocks beneath the sub-soil, and that the mode of culture must be greatly influenced thereby. The soil itself is, indeed, formed from the *debris* of the rocks at higher elevations, which have been decomposed by the influence of the atmosphere, and by the action of water, and then deposited in the low-lands and vallies. This fact, our author conceives, establishes the importance of the study of geology in effecting agricultural improvements, and he shows that the productiveness of land is dependent on the nature and the dip of the subjacent strata. Without, however, wishing to disparage the utility of geology, it appears to us to be somewhat a strange way of ascertaining the character and fertility of the soil, to examine the nature and positions of the rocks which lie far beneath. It is seeking in the dark below for that which lies patent on the surface, and instead of adopting the previous practice of ascertaining the geological features of a country from its external developments, we must reverse the plan, and commencing underground work our way to daylight. Mr. Whitley appears to have mistaken the province of geology for that of agricultural chemistry, for it is to the latter science that most of his observations apply. The book, nevertheless, contains much valuable information, and it is presented in a most comprehensive readable form, calculated to be understood by those who are not supposed to be scientific chemists. He enters fully into the value of the inorganic constituents of plants, which physiologists have, up to a late period, considered rather as accidental than as essential ingredients. These inorganic substances constitute the ash which remains after the combustion of the vegetable matter. The analysis of 1000 parts of hay, potatoes, wheat, and of wheat straw, when perfectly dry, affords the following results:—

	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.
Hay........................	458	50	387	15	90
Potatoes....................	474	50	378	21	77
Wheat......................	461	58	434	23	24
Wheat Straw...............	484	53	389½	3½	70

Thus, the ash appears to constitute no inconsiderable portion of the substance of vegetables, though its nature has been much neglected, as it was generally considered not essential to their growth. It is to this neglected part of agricultural chemistry that Mr. Whitley directs his principal attention. Analysis of the ashes of different plants prove them to be composed of soda, potash, lime, magnesia, silica, and sulphuric and phosphoric acids in different proportions, each plant containing distinct proportions of those substances. It appears clearly, therefore, that attention to supplying those ingredients, as one part of the food of the plants under culture, is essential. It has been found that wheat cannot be produced on a soil destitute of potash and magnesia, and that the chief advantage gained by permitting land to lie fallow is, to enable it to obtain by atmospheric influence the portion of potash, or of the phosphates it has been deprived of—the effect of the atmosphere being to melt down by a gradual decomposition the insoluble elements of the soil, in which those substances are generally contained. This object is now gained nearly as effectually by growing a crop of turnips or potatoes on the ploughed land, as by letting it lie fallow; for as those vegetables require very little alkali, the soil is not deprived of that element by their growth.

It must not be supposed, however, that Mr. Whitley confines his views on the improvement of land to the residual parts of plants; he would in that case be like the farmer, who had tried all kinds of medicines to make his horse fat, but had forgotten *oats.* The inorganic matters supplied to the soil, though essential in assisting the growth of vegetables, do not seem to constitute portions of their *food.* Their natural food consists of hydrogen and oxygen, carbon and nitrogen. The two former are supplied abundantly by water, and hence the importance of that liquid to vegetation. Carbon and nitrogen are supplied by the vegetable and animal matters in the soil: carbon is also absorbed by the leaves of plants from the air during the night. It is for supplying the carbon and nitrogen, as well as for adding to the stock of the phosphates, that manure is especially required, nor does Mr. Whitley attempt by any geological contrivance to dispense with those essential components. He shows, however, that without attention to the supply of the geological constituents of plants, the application of manure may be useless. With regard to the formation of manure, he strongly recommends that preference should be given to animal substances, and he observes that the carcases of dead horses or cattle would be much more profitably employed by the farmer as manure, than by disposing of them as food for dogs.

Our readers will perceive from the sketch we have given of Mr. Whitley's book, that though it has not much relation to geology, it treats of matters of great importance for the consideration of the agriculturist, and that its importance is increased by directing attention to a branch of vegetable physiology.

Art. V.—THE PHENOMENA OF COLLISION.

Smeaton's experimental inquiry into the nature of mechanic power, and into the theory of impact, is the text we take for our present remarks, as it is the source from which we derived our first acquaintance with the abstruser parts of this interesting subject. The work is in the form of a spare octavo —the substance of a few papers read before the Royal Society sixty to eighty years ago, giving the details of repeated series of experiments on subjects connected with the author's professional duties, generalized and reasoned on with his peculiar acuteness and sagacity, and characterized by singular simplicity and modesty. There is little parade of calculation in these papers, and none at all of the mystifications of algebra; yet they are to be regarded as models of philosophical research, and are eminently fitted both to regulate and to inspire a spirit of scientific inquiry.

The following paragraph is introductory to the essay on Collision:—"My present purpose is to show that the true doctrine of the collision of bodies hangs, as it were, upon the same hook as the doctrine of the gradual generation of motion from rest, considered in a former paper; that is, that whether bodies are put into gradual motion, and uniformly accelerated from rest to any given velocity, or put into motion in an instantaneous manner, when bodies of any kind strike one another, the motion, or the sum of the motion produced has the same relation to mechanic power therein defined, which is necessary to produce the motion desired." Again:—"It seems, therefore, that without taking into account the collateral circumstances both of time and space, the terms, quantity of motion, momentum, and force of bodies in motion, are absolutely indefinite; and that they cannot be so easily and fundamentally compared as by having recourse to the common measure, viz., mechanic power; while, at the same time, Time, properly speaking, has nothing to do with the production of mechanical effects, otherwise than as, by equally flowing, it becomes a common measure."

It is very common to compare the respective energy of impact and pressure, or, rather, to measure the former by the latter, assuming a certain pressure as the unit of force. Pile-driving has been a favourite instance of this; and much assiduity has been wasted in the fruitless attempt to determine a statical expression for the amount of impact of the ram upon the pile-head. Let us try to find how far they are comparable, and how far they are to be deemed, in the language of mathematics, *irrational;* and here we shall avail ourselves of the hint given in the first paragraph we quoted.

Imagine, then, the extreme case—of the pile affording the same resistance to the descent of the ram as gravity does to its ascent; then, of course, the force of impact during the unit of time would be just equal to the weight of the ram, and the duration of the impact would be equal to the time occupied by the free descent of the ram from the height to which it was raised. The greater the resistance offered to the descent of the ram, the shorter will be the duration of the impact, the less will be the space fallen through, and proportionately greater will be the energy of the action; and thus it comes to pass that the resistance presented by the pile, or (in the case of a perfectly rigid pile, without inertia) to the descent of the pile, is the only measure of the energy of impact produced by the ram.

Were this resistance infinite, then the motion of the descending weight would be destroyed in an infinitely short time, which could only be effected by an infinite force; since nothing short of such force could in that case produce any definite effect at all. Of course, by the term infinite, or indefinitely great force, we mean, as compared with simple pressure or weight. This, though an extreme case, is a strictly legitimate supposition, involving neither impossibility nor contradiction. Instead, however, of a merely infinite resistance, let us go a step farther, and endeavour to conceive what the French philosophers would term an "absolute resistance," implying absolute hardness in both the subjects of collision. It will not do in this case to say that the energy of impact is infinite; we must go a step higher, and are led to the more startling conclusion, that when collision has taken place, the ram is in a state of motion and of rest in one and the same instant,—an inference strictly logical, and inevitable upon the above hypothesis,—but yet leading to the very extraordinary result, that the idea of absolute hardness in connexion with the communication of motion, involves not only an impossibility but an absolute contradiction.

The received and established doctrine of the collision of inelastic bodies involves another contradiction (apparent only) which the experiments of Smeaton seem to remove. If a body moving at any velocity meet another equal body at rest, the two will proceed after collision with a common velocity, being half that of the striking body; but the two bodies will rise in opposition to the force of gravity, only one-fourth of the space that the first would, so that only one half of the mechanical power is now exerted. The question arises, what has become of the other half?

Passing over the case of hard non-elastic bodies, as being already disposed of, let us consider the case of soft bodies. And here it is plain no power can be absorbed in changing the figure of the bodies, *that* being precluded by hypothesis:—whence, then, this defalcation of *vis viva?* a question not sufficiently answered by the enunciation of the law, that the quantity of motion, as measured by the mass, × the velocity, continues unchanged. A little consideration, however, will show that if the collision of hard bodies involve a contradiction, the communication of motion by impact, from one perfectly soft body to another, is a physical impossibility.

The truth is, neither hardness nor softness, perfect or imperfect, absolute or partial, has anything to do with the phenomena of impact, and when considered to the exclusion of other properties, serve only to involve the subject in such confusion, as is only to be cleared up by the false lights of a visionary hypothesis. The communication of motion by impact, then, implies the idea of repulsion in connexion with yielding; and in the development of this idea, the ingenuity of Smeaton is shown forth most favourably. By a peculiar mechanical arrangement he provided himself with bodies, which during concourse were perfectly elastic, and that through a considerable compass; but whose elasticity was destroyed by the springs becoming locked the instant the aggressive part of the impact was completed, and the resilience about to take place. He found that bodies thus circumstanced presented results identical with those ordinarily produced by inelastic bodies, the velocity after impact being half of that before, and the two bodies ascending together one-fourth the space that the first had fallen; but in this case one-half the mechanic power disappears—not lost, however, but only absorbed or locked up in the bent springs, producing a species of latent elasticity which was, as it were, congealed before it had time to produce recoil; and that a *bonâ fide* half is thus disposed of. Smeaton then contrived a method of suddenly liberating the dormant elasticity he had succeeded in locking up, when an effect was produced corresponding exactly to one half the original power. By these experiments he made the inference clear, that in ordinary cases of collision of equal non-elastic bodies, half the mechanical power is absorbed in changing the figure of the meeting bodies.

The consideration of time, as affecting the energy of impact, combined, as it necessarily is, with that of space, through which the force acts, serves to explain many of the familiar phenomena of collision, as well as of suddenly excited tension. And we thus see the connexion between hardness and brittleness, and the impossibility of uniting the two extremes; for two perfectly hard substances meeting each other, though with the slowest possible velocity, could not continue to exist. Every body, when solicited by an external force, tending to produce motion from a state of rest, or to change its velocity, requires a certain time to have that force propagated through its substance; and if that time cannot be afforded, disintegration, fracture, or separation of the parts, more or less complete, must be the consequence. The due expansion of this consideration would lead us into the very interesting doctrine relating to the modulus of elasticity—one of the most attractive and not the least subtle departments of mechanical science.

Art. VI.—THE ENGINEER'S AND MACHINIST'S ASSISTANT.

The Engineer's and Machinist's Assistant: being a Series of Plans, Sections, and Elevations of Steam Engines, Spinning Machines, Mills for Grinding, &c., taken from Machines of the most approved construction at present in operation: with Descriptions, and Instructions for drawing Machinery. By D. Scott, Engineer. Also, *An Introductory Essay on various departments of Machinery.* By Alexander Jamieson, Esq., LL.D. Glasgow: Blackie and Son. 1843.

The Conditions of this publication, we are informed in the advertisement, are, that the work will be published in parts, at 2*s.* each, containing 4 and 6 pages of plates, alternately, of an imperial quarto size, with accompanying letter-press; and that the whole will extend to about 24 parts. As "the publishers are convinced that the work they now offer is adapted for extensive usefulness, and trust that their names are a sufficient pledge that the plan laid down will be executed, in all its parts, in the most satisfactory and creditable manner," we dare not flatter ourselves that any comments of ours can either ruffle their composure or disturb these convictions. But as the Engineers and Machinists of the kingdom, for whose behoof the work is got up, hold a considerable place in our regards, we have been at some pains to examine the first two numbers of the issue, premising that these being mainly introductory, are by no means to be taken as criteria of the whole. We would observe, that the work appears to be of a somewhat mixed character, exhibiting what we may rather term a conglomeration than a combination of some not very reconcilable properties; and, were we to adapt our vocabulary to the somewhat unseemly grouping which it presents, we should have recourse to certain harsh-sounding and incongruous appellatives to mark our sense of the inconsistency. Unwilling to let the work pass in the integrity of its iniquity, we should take occasion, for instance, to advert to the demureness of its presumption—to the sublimity of its bathos—to its unfathomable simplicity—and the uncommon commonness—of the whole.

We cannot be surprised, though we may be disposed to growl, at the discrepancy which appears between its professions and its performances—seeing that its pretensions themselves are, if possible, still more irreconcilable. Professing for its object, "to have the practical labouring Engineers and Machinists instructed in their peculiar branches as liberally as possible," it forthwith demits itself to the character of a mere drawing-master's manual. Promising that the whole information shall be as purely practical as possible, it commences with the elements of unmixed mathematics, including some of the higher branches of plane geometry. And after informing us that the work will be issued at a rate, and by a mode of publication, rendering it attainable by the humblest Artizan, it coolly gives us to understand that the proposed *condition* of the whole 24 parts is—three pounds sterling—a sum which the actual condition of many of the working classes places as far beyond their reach as if the proposed sphere of its publication were the planet Saturn. Indeed, the price of the work, the style in which it is got up, and the nature of the embellishments, are such as would be thought not without extravagance by nine-tenths of the members of the Institution of Civil Engineers.

We do not deny, though at the same time we do not affirm, that there are sundry things possessing a considerable share of merit in the publication. We would notice, in particular, some very pretty and accurate plates of veneer-sawing machinery, and some useful problems on constructive geometry and perspective: but the effect of these is spoilt by a sort of lack-a-daisiacal savour, and the plethoric jejuneness with which the whole is introduced and paraded. A few extracts from the Prefatory Essay will render this very plain: and first, for the following sober piece of mis-statement:—

> "Our workmen far excel the artizans of other nations in genius to invent, in skill to fashion, and in assiduity to finish, whatever they undertake; but they chiefly excel in contriving tools with which to complete their designs, and to confer

on the workmanship all the perfection of which it is susceptible. To this truth every observer will assent, who has calmly contemplated the nice trains of mechanism in our manufactories, or the giant steam-engine by the shaft of a mine, on a railroad, or in a ship."

The recent Parliamentary investigations into the state of the manufactories in Switzerland, &c., would lead us simply to reverse the first clause, and to maintain that the artizans of every other nation excel the English mechanic, if not in skill to fashion, yet undoubtedly in genius to invent, and taste to finish. Again—

> " The knowledge of our various artizans and mechanics is the result of an education of a very high order. In the workshop, the manufactory, or the steam-ship, we see them enter on their task with the most thorough understanding of the various intricacies of the operation in which they are engaging. We see, then, well-trained hands subjecting to the dominion of their experience all the materials requisite for giving existence to some new and untried forms and arrangements of mechanism which shall be applicable to a desired purpose.
>
> " All the artistic dexterity shown in the various manipulations by which the task is accomplished, appears the result of a species of intuition, while, in point of fact, it is only the development of that scholarship which every master in his art, which every man learned in his calling carries about with him as a matter of course; constituting him the owner of a property of which neither fortune nor locality can deprive him."

This is, we think, a pretty fair specimen of the kind of writing commonly called nonsense. The following paragraph approaches pretty closely to the confines of common sense:—

> " The evidence of this lies before our eyes, in those 'store-houses of every convenience, of every luxury that man can desire, which deck our crowded streets of cities.' In every nook and corner of the world may be found our beautiful fabrics of cloth of all sorts, and those endless articles of commerce, from the most insignificant toy to the most perfect chronometer. Nay, more; we put our manufactured machinery, perfected by a long series of experiments, into the hands of other nations; so that they supplant us in the markets with the produce of tools, which, but for our skill and science, our capital and industry, would, perhaps, never have had existence."

The following profound exposition of the object of the work, will, we fear, serve to mystify such little insight into this mysterious question as our readers may by this time flatter themselves that they have attained :—

> " Its object is to improve the professional education of the workshop, by making artizans familiar with recorded principles which are peculiar to their business; to set before them clear views of mechanism and mechanical relations, which by practice have become 'part of the habit of their minds,' and to enable them to apply those principles as well to the structure as to the labouring force of machinery."

We conclude our extracts with the following touching *éloge* upon THE DAMASKS OF OUR OWN TIME :—

> " If we consider the great variety of the designs given to this textile fabric, on which no particolours appear, we cannot help greatly admiring the skill of the weaver, who could, by means of his loom, produce from weft and woof, of the same colour, such exquisite figures, which are brought conspicuously to the eye by the effect of light alone. We are perfectly aware that, without light, we should have no diversity of colours; but, when we behold a magnificent table-cloth white almost as snow, from end to end a rich picture of geometrical figures, heraldic devices, or copies of natural productions, we cannot help admiring the ingenuity which planned, and the mechanical contrivances which have enabled the workman to produce so much of all that is beautiful in the damasks of our own times,"

Neither can we—though we should be loth to spin so much fustian to illustrate such a topic. But, enough: we cannot waste more words upon this respectable farrago. The utmost that we can say in its favour is, that it reaches the summit of mediocrity.

Art. VII.—BIRD'S NATURAL PHILOSOPHY.

Elements of Natural Philosophy, being an experimental introduction to the Study of the Physical Sciences. By Golding Bird, A.M., M.D., &c. Second Edition. London.

To write a clear and comprehensive introduction to the physical sciences, is a task of much more difficult accomplishment than it may on a first view appear. In such a work, the author has to exercise judgment in the selection of the points for illustration, to present the diversified, and often difficult subjects in their clearest possible forms, and not only to describe phenomena, but to explain their causes, when those causes have been discovered. He must be careful at the same time to avoid announcing as established facts theoretic explanations of but questionable foundation, and he should constantly point the students' view towards the vast unexplored regions of science, whence laurels of undying renown are still to be gathered. We cannot say that Dr. Golding Bird has realised all these high requirements, though he has nevertheless produced a good book of the kind. It is neither so clear nor so free from technicalities as an introductory work ought to be, a peculiarity partly, perhaps, to be ascribed to the circumstance of its being especially addressed to a profession which affects technicalities and mysticism. The style is not inviting, and the matter, from the apparent want of original thought, bears rather the character of a hasty compilation, than the production of a mind, in which the subjects have been well digested. We have said, however, that it is a good book of the kind, and its merits consist in the judicious nature of the compilation, and in the comprehensive manner in which some of the subjects have been treated, so as almost to pass beyond the limits of a merely introductory work. The volume is divided into two sections; the first being devoted to "the physics of ponderable matter," the other to "the physics of imponderable matter." In the first section are included the general properties of matter and dynamics, hydrostatics, "pneumostatics," hydro-dynamics, and acoustics. The second division includes magnetism and electricity in all their phases, light, and its various properties, "thermotics," or the science of heat, and photography, the two latter branches having been added in this edition. Even in the arrangement and titles of his subjects, the disposition to coin new technicalities rather than to dispense with them is apparent; and the novelty exhibited in the departure from the arrangements in preceding works on the physical sciences is without much apparent advantage.

It is not to be expected, neither would it be fitting, in an elementary work, that the author should announce any discoveries, or propound any new theories. His business is to deal with known facts in their elementary forms; it is therefore only the manner of setting forth those facts that comes properly within our notice. Though Dr. Bird appears to be less dogmatic in his expositions of the phenomena of nature than many of his predecessors, he has, nevertheless, committed the very prevalent fault of adopting previously received opinions without sufficient examination, and of announcing them as fundamental truths. Nothing is more detrimental to the advance of knowledge, than the inculcation into the minds of students of error, or of questionable theories as established facts; for the impression generally remains throughout life, and gives a false bias to the inquiring mind. We shall, therefore, direct attention more especially to some of those portions of Dr. Bird's work, which we conceive to be open to this serious objection.

Among the general properties of matter, Dr. Bird enumerates *inertia* as one of the principal, and he observes, "this is not merely a passive sluggishness, but an actual resisting force, which increases in the direct ratio of the increase of weight of the body." This manner of attributing the resistance of bodies to the *active idleness* of matter is not only a contradiction in terms, but it has, in our opinion, been the means of complicating many questions connected with force and resistance. Though high authorities can be quoted for its adoption, common sense, which is a higher standard of appeal, at least calls for some alteration in the name, and had not the signification been disguised in Latin, it could scarcely have stood its ground in the middle of the nineteenth century. The whole operations of nature, in fact, contradict the assertion that matter is idle. Universal motion and activity seem to be the pervading principles throughout creation, and the resistance which any body offers to motion in any given direction, does not arise from its objective laziness to be stirred, but from its being already acted on by some other force which tends to maintain it in its previous state. The difficulties in which philosophers have involved themselves by admitting idleness to be an essential property of matter, is shown by their being obliged to assume the ridiculous contradiction of activity conjoined to that property, and to resolve it at last into an energetic resisting force.

In considering the laws of motion and of gravitation, Dr. Bird adopts some errors which deserve to be noticed. In viewing friction as an obstacle to motion, he makes no distinction between the resistance which a ball or a wheel encounters, when rolling along the ground, from the opposing projections which has to surmount, and the resistance which arises from the rubbing of the nave of the wheel against the axle. The latter only can properly be called *friction*, for in the former case the resistance does not proceed from the rubbing of the substances against each other, but is the consequence of the rolling body having to be lifted against the force of gravitation over the opposing points. A more misleading error consists in stating gravitation to be "by far the most important source of opposition to the continuance of motion;" for though bodies projected vertically or horizontally are brought to rest by being attracted to the earth, yet if a ball could be set in motion on a perfectly smooth and level plane, without meeting any obstruction from the atmosphere, the attraction of gravitation would present scarcely any obstacle to its continued motion. In mentioning the development of what is termed "centrifugal force" by circular motion, we are glad to find that Dr. Bird discountenances the notion so frequently entertained, that a new force is actually generated by the rotation of bodies. The fact that whenever a body moving rapidly in a circle is liberated, it moves in the direction of a tangent to the circle, and not as if proceeding from its centre, ought to have long since disposed of the erroneous opinion that a force acting from the centre is generated by curvilinear motion. We have known a practical engineer waste the best years of his life, together with all the savings of his younger days, in the vain endeavour to apply the "centrifugal force" as a motive power! and nothing but dear-bought experience could convince him he was wrong; for he founded all his calculations on the Principia of Newton.

We perceive that Dr. Bird has fallen into the same error respecting the centre of the earth being the centre of gravitation which has been committed by so many philosophers, and which led the late Sir John Leslie into the most ridiculously absurd calculations respecting the density of matter in the centre of the globe. The force of gravitation depends on the attraction of the whole mass of matter in the globe. A body on the surface of the earth is attracted not only perpendicularly towards the centre, but in all directions where there is any matter to attract; and this force is not confined to matter lying between the centre and the body acted on, but it extends to the whole mass within the diameter of the earth. The resulting direction of these different forces is indeed towards the centre, but this is merely because the greater mass of matter lies in that direction. Nevertheless we find it often assumed, as it is by Dr. Bird, that some specific attractive force resides in the centre of the earth, and that the attraction diminishes according to the square of the distance from the attracting point; though if any body were placed under the surface, nearer to the centre, the attraction would diminish; not merely because there would then be a smaller quantity of matter below to attract, but there would be a mass of matter above, exerting an attractive force in an opposite direction. In the concluding portion of the following passage, Dr. Bird seems to be aware of this fact, though the commencement is in direct contradiction to it. "Bodies weigh heavier nearer the poles than at the equator, *on account of the former being nearer the centre of the earth than the latter*; and if it were possible to place any body in a cavity at the centre of the earth, *it would be equally attracted on all sides*, and consequently remain suspended in space, like the fabled coffin of Mahomet." Were it not, however, for the more rapid rotation of the earth at the equator than near the poles, the circumstance of the greater mass of matter in the equatorial diameter would cause bodies to weigh heavier instead of lighter.

In considering the action of the mechanical powers, Dr. Bird confines his view to the six generally enumerated, viz.: the lever, the wheel and axle, the pulley, the inclined plane, the screw, and the wedge. He does not enter into the *rationale* of their actions, which ought to have been done; nor in alluding to the pulley is any notice taken of the mechanical power gained by a fixed pulley when the power and the resistance move together. It is difficult on any other principle than that of the lever to account for this gain of power by the fixed pulley, and we are glad to find that it is to this principle the author refers the action of all pulleys, in contradistinction to the dogmatical assertions of some other writers, who affirm that the whole effect of the pulley is attributable, in some unexplained manner, to the tension of the cord.

A curious property of membraneous substances, which is exhibited in the phenomena termed endosmose and exosmose, is noticed by Dr. Bird; and it is a subject which deserves more attention than it has hitherto received. A piece of bladder tied at the end of a wide tube will be perfectly air-tight, though it will give passage to liquids. This may be readily proved; for if a solution of salt or sugar be poured into the tube, and the end covered with bladder be immersed in water till both liquids are at the same level, the water will penetrate the bladder, and the liquid in the tube will rise several inches above the level of the water. This curious property of membraneous and of porous diaphragms is applied in the construction of voltaic batteries where two exciting liquids are employed. In these cases, the salt being decomposed by chemical action with the zinc, one of its elements passes through the diaphragm to unite with the metallic salt in contact with the copper. These minute pores of membraneous substances, which are permeable by liquids, though impermeable to air, serve the most important uses in the animal economy. The same phenomena are exhibited by some kinds of porous earthenware, which will contain the compressed gas forced into soda water, though it permits the water to escape through the air-tight pores.

In the mode in which "the physics of imponderable matter" are treated, we do not observe much to require comment. These sciences are, for the most part, comparatively new; and the theories propounded for the explanation of the phenomena connected with them are very properly mentioned as suggestive rather than positive. We wish, indeed, that the author had spoken even more doubtingly than he does on some of the theories put forward. The assumed austral and boreal magnetic fluids, for example, have had more importance assigned to them than was their due, since the discoveries in electro-magnetism have shown the close connexion subsisting between magnetism and electricity. The adoption of the terms idio-electrics and anelectrics, for the better understood and, as it appears to us, more suitable terms, electrics and non-electrics, or non-conductors and conductors, is an instance of Dr. Bird's predilection for high-sounding phrases, which, if they serve no other use, will at least look knowing. These are the faults which pervade the book. It is an ample compilation of facts, illustrated by woodcuts innumerable; but the execution is considerably marred by the work being addressed to medical students, and smelling too much of the shop.

Art. VIII.—THE BUILDING ARTS.

UNDER-PINNING.

As there are numerous cases in which the practice of under-pinning has to be resorted to, where for instance the foundations of abutments, or of retaining breast walls, have been carried away by the action of the sea, by strong currents, or other causes; or where again a necessity exists for deepening the bed of a river, in the close vicinity of such erections; and as moreover the practice of under-pinning, appears to be at best but imperfectly understood by many engineers of the present day, a brief account of a somewhat novel, yet highly efficient plan, which was adopted with the most perfect success by the writer, in a work of considerable magnitude and importance, may prove not uninteresting to the student in practical engineering.

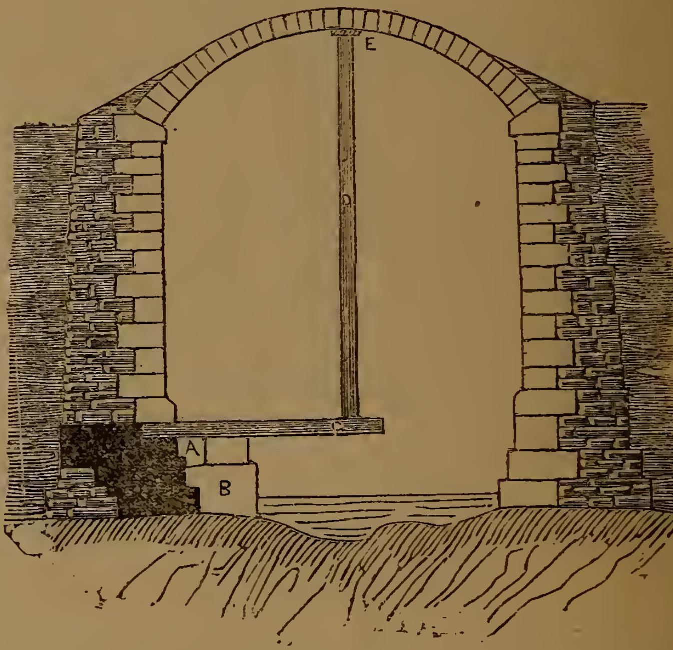
It must be premised, that in order to perform the operation of under-pinning with success, the new masonry which it is found requisite to insert at or below the foundations, must so unite with the original upper structure as when completed to form one mass so perfectly solid and compact, that it might not be known to the passer-by in future years, that the practice had been resorted to at all.

The abutments of the work, in which the method already adverted to was adopted, were built on a species of shaly rock foundation, and were laid during the summer months, only a few inches below the surface of the water. For many years the bridge stood firm, without the slightest appearance of failure or decay, though the water at the time of floods, which were by no means of unfrequent occurrence, rose to a height of four or five feet above the foundations.

Despite the appearance of soundness and stability, however, which seemed to characterize the building, it was subsequently made evident that an unseen agent was busily at work, undermining and destroying the foundations; a constant wearing away was in fact going on, and an extraordinary flood, which swelled the little river far beyond its natural dimensions, and swept with great velocity through the arches of the bridge, carried with it in its course several of the front ashlars, and a part of the backing of the north abutment, and in fact undermined the bridge for nearly the whole length of the arch.

The masonry, which consisted of good-sized ashlar, placed alternately header and stretcher in front, well backed with coursed rubble, and all laid in excellent lime mortar, had been so well and firmly constructed, that, after the undermining alluded to had taken place, no flaw or fracture was discernible in the face of the work, which remained as sound as ever. It needed, however, no spirit from the world of air to tell what was evident to all, that, unless prompt and energetic measures were at once adopted, the whole abutment, with the arch which it carried, must be tumbled into the bed of the river.

The plan which was adopted is exceedingly simple, and will be readily understood, by reference to the annexed sketch, which represents the section of a similar but less complicated work.



Strong beams of oak timber, about eight inches square (marked in the sketch C), and of sufficient length to extend from under the front ashlar to beyond the centre of the arch, were placed horizontally, as shown in the sketch, and at intervals of four or five feet apart. Two ashlars, A and B, were disposed so as to form a fulcrum for the lever C. A plank, E, was placed along the whole length of the arch, and an upright piece of timber, D, being tightly wedged between E and C, completed the operation of temporary support. There being a heavy embankment over the arch, there could be no danger of the arch-stones above E being forced up. The masonry lying between the several levers was then removed, and the foundations were lowered to the requisite depth. When this was completed, and brought as close up to the levers as possible, they were then removed, and the front ashlar and backing were regularly introduced; the whole work being rendered as firm and solid as if no accident whatever had occurred.

In the case of a breast-wall, it is true, there is no arch to press against the upright, D, and counterbalance the gravity of the wall; but, in lieu of the arch, all that would be necessary is the substitution of a sufficient weight upon the point of the lever. The wall being in this manner sustained at the proper intervals, the process of under-pinning may proceed with all convenient expedition.

Pointing.

There may be some who are ready to exclaim that this is too unimportant a subject to be worthy of a regular and formal notice. To those, however, who have been accustomed to observe and trace the operations of nature throughout any part of her wide domain, we need scarcely pause to point out how apparently insignificant is the cause which often precedes the most gigantic results—how liable is this cause to escape observation, and how cunningly concealed from the idle gaze, which takes no pains to look beneath the mere outer surface of all that passes around. Still less need the practical man, in any department of construction, be told how narrowly should trifles be watched, and minute details be attended to. The operations of a single rat or a mole have, ere now, overturned the labours of a thousand men continued during the same time, by boring through a massive embankment, and discharging the water of a canal or reservoir; an effect accompanied by serious injury to the villages and country adjacent. Even worms, insignificant and harmless though they commonly be, have, at least on one occasion within the writer's remembrance, produced in the same manner a very disastrous result; while the operations of certain small shell-fish which attack timber piles, and which are at this time ravaging the solid masonry of Plymouth breakwater to an alarming extent, are too well known to require notice. These instances will afford some apology for what may at first sight appear trivial in the following observations.

There are few subjects more deserving of censure than the slovenly and inefficient manner in which the operation of pointing the joints of masonry is commonly performed; a fact, which is the more surprising, when it is considered how much, and how palpably, the future stability of a building depends upon its proper performance. Pointing, as generally practised in these days, seems to be regarded more as a matter of ornament than of use; the operation is consequently performed in so superficial a manner, that the first frost forces it out, and the wall thus pointed stands only one winter, after which the operation must be repeated. But this need not be the case, if due care were exercised in its proper execution. The common practice is just to scrape out the more crumbly particles of the mortar with which the masonry was set, and then plaster the joints with new mortar finished in such a manner as to present a good appearance to the eye, and the job is considered to be perfect. But what is the fact? The new mortar has not been inserted to such a depth as to have a sufficient hold in the wall, water finds its way in between the old and new mortar, and the first frost readily expands the water, and throws out the pointing, more moisture follows, and succeeding frosts penetrate still further into the building. This constant repetition of damp and frost soon destroys the external appearance, and eventually causes the rapid decay of the entire fabric. Too much attention, indeed, cannot be paid to this subject, as all buildings exposed to the alternations of the seasons, or the vicissitudes of the weather, must soon fall into decay, if means be not taken effectually to secure the joints against all the variations of wind, rain, and frost. In buildings which are exposed to the constant action of water, the work of destruction will, of course, proceed much more rapidly than in dry buildings, and the difficulty of protecting the internal parts of the structure is materially increased.

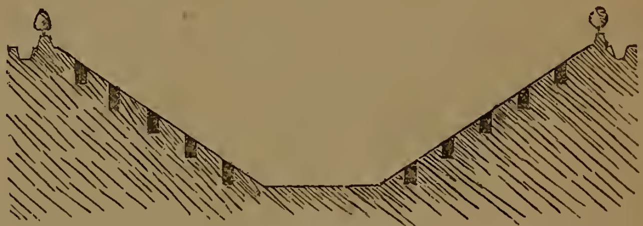
In buildings that have been constructed during the prevalence of wet weather, or towards the end of the year, it is impossible that the mortar can set in a perfectly hard manner, and it will almost invariably be found necessary to point such buildings early in the spring of the ensuing year. The operation, if then performed in a proper and efficient manner, need not be repeated for fifteen or twenty years, whilst an inefficient performance will call for its repetition in two or three years. The following is the only good practical method of pointing which is likely to endure any length of time against the combined operations of wet and frost. The first process is to scrape out the joints of the work with a steel instrument, constructed with a shoulder so disposed that the instrument cannot penetrate into the joint to a greater depth than one inch, which is about the proper depth to be scraped out; for if the joint be made deeper it will be found very difficult to press the mortar properly in, whilst if the joint be not sufficiently deep, the frost will force the material out. This once effected to a uniform depth, each joint should be carefully brushed out, with a flat-shaped brush made of long bristles. The mortar, composed of a mixture of good lime and clean sharp sand, should then be introduced with a trowel, taking care to fill the joints as flush and full as possible. It should also be observed, that the joint ought always to be struck downwards. It is the invariable custom of masons and bricklayers, if it be not specified to the contrary, to strike the joint upwards, but this is a very bad practice, and one which should be studiously avoided, for this reason: that when the joint is struck upwards, a small edging of mortar always remains protruding immediately above the joint, this protrusion presents an obstruction, and affords a partial lodgment to any rain-water that may trickle down the face of the building, thereby facilitating its admission into the joints. On the other hand, when the joint is struck downwards no such projection is caused, and the water passes readily over the surface. This completes the operation of pointing, which, with the exercise of a small degree of caution, may thus be made a most effectual work.

Many practical men may prefer other descriptions of mortar than that which has been hinted at, and it is very probable that other equally suitable compositions may be employed, with similar, or perhaps greater advantage; but the object of those remarks is not so much to enter upon the merits of the various descriptions of mortars, as to describe the process to be pursued in substantially pointing a building. With regard to structures, however, which are much exposed to the action of water, such as lock-walls, piers, and abutments of bridges, dock-walls, &c., it may be briefly observed, that they should never be pointed with any material which requires time to harden it, and probably nothing will be found more applicable to such structures than Roman Cement. In cases, also, where a work of either brick or stone is laid in a weak description of mortar, such as that made from the soft chalk of Norfolk, and even from the white chalk, which still to some extent supplies the London market, we should always recommend a stronger mortar to be used for pointing the joints. The mortar of weak rich limes may answer tolerably well in the interior of the work, where it is concealed from atmospheric influence, but it seldom continues to occupy the face of the joints through the first winter, and the expedient of pointing these either with cement, or with some hydraulic mortar of repute, may as well be adopted in the first instance.

ART. IX.—REMARKS ON CUTTINGS, EMBANKMENTS, AND OTHER EARTHWORKS.

General method of Securing the Slopes of Clay Cuttings.

SINCE the publication of the earlier articles on this subject, our attention has been more practically directed to the best means of carrying out the general principle there advocated, of cutting off all the water before it reaches the face of the slope. It will be remembered, that the plan proposed for this purpose was that of trenches filled with rubble stones from the top to the bottom of the cutting, so as to constitute a sort of porous wall or dyke, through which all the water which finds its way up to it may freely percolate, and pass off to one extremity or other of the cutting without ever reaching the face of the slope. We have considered the practicability of forming a single uninterrupted trench of this kind at the back of each slope, as at first suggested; but taking into account the difficulties and expense of keeping up the sides of such a work by means of shoring during its execution, we are led to propose as a substitution a series of parallel trenches stepping up the face of the slope, each one commencing at the top level of the one immediately below it, and the whole suite being equal in depth to one single trench all the way from top to bottom. The sketch below will render this explanation quite clear. It is the cross section of a cutting 40 feet in depth, with slopes of $1\frac{1}{2}$ to 1. There are five trenches in each slope, all of the breadth of 3 feet, and about 6 feet in depth, this being about the size of a gullet in which a man can work without inconvenience, and without risk of the sides falling in, provided the trench is kept filled in behind him as he advances.



The top trench need not begin at a higher level than the bottom of the soak drains at the top of the slope, as shown in the sketch. Where the quantity of water to be intercepted by the trench is very great, it will relieve them in some measure to lay a rough tile in the bottom of each, in order to give a freer passage to the water than it might otherwise have, in case of the bottom of the drain getting clogged or choked up in any way. The cost of this plan, which will protect the slopes just as effectually as an entire trench, will not exceed eight guineas per yard lineal for a cutting of 40 feet deep; and for cuttings of greater or less depth the expense may be taken at about 4*s.* 4*d.* per yard lineal for every foot in depth of cutting. This outlay is quite insignificant compared with that which some companies have incurred to secure their slopes.

Physical Geography of the Oolitic country, as influencing Lines of Railway and Canal.

The oolite formation is one of great extent and importance, presenting many remarkable physical features, many alternations of hill and valley, wood and plain, many tracts of dry, arid, unfertile soil; others of rich luxuriance, bearing innumerable rivers and streams; some without a tree or shrub even, to mark divisions of property; and others distinguished by noble forests and royal chases, containing some of the finest timber which England produces.

This series consists of three great members, the first of which is called the upper oolite, and comprises the sand and freestone of the Isle of Portland, or the strata which correspond to these throughout the range, together with a thick mass of blue clay, called the Kimmeridge clay, a name also taken from the Isle of Portland. The second member consists of calcareous grits, and freestones, with another thick argillaceous mass, termed the Oxford clay, from its large development in the neighbourhood of that city. The third, or lowest member, consists of coarse cornbrash, marbles and shelly limestones, freestone of Cheltenham, fuller's earth, sand, and occasional beds of clay and marl. This triple series extends from the coast of Yorkshire in a southerly direction into the counties of Leicester, Northampton, and Huntingdon; and thence in a south-westerly course to the shore of the English Channel in Dorsetshire.

The oolite in Yorkshire is largely developed along an extensive and bold projection of the coast line, from Filey Bay to near the port of Redcar, at the mouth of the Tees. Its western boundary presents a lofty escarpment towards the lias, and sweeps round from the coast, including in its range the Hambleton and Howardian hills, crossing the river Derwent near Castle Howard, and curving round to the south by Pocklington down to the Humber, which it crosses some miles above Hull. Its eastern boundary sweeps round from Filey Bay, running parallel with the course of the Derwent for more than seventeen miles, when it turns southward to the Humber, at the crossing of which the width of the formation is contracted to about four miles. The tract of country included within these limits comprises the eastern moorlands of Yorkshire, together with the vale of the Eske (Eskdale) on the north, and the vale of Pickering and Rye Dale on the south; the latter being bounded by the Hambleton and Howardian hills already mentioned. The district north of Eskdale throws off a number of small streams, which flow directly into the German Ocean, and is only remarkable for the important cliffs of lias shale by which its outline is indented along the coast. The moorland district has a steep escarpment towards the north, where it is flanked by the lias and shales of Eskdale. A large number of streams flow over it, taking their rise in the numerous valleys which furrow its surface, and pursuing a southerly direction till they all unite with the Derwent in the vale of Pickering, and are carried by this single channel down to the Yorkshire Ouse, and thence into the sea. The moorlands principally consist of the middle and lower members of the oolite formation, and their general dip is to the south-east. Through a line of the best levels which this irregular district affords, the Whitby and Pickering railway extends from the vale of Pickering to the port of Whitby. This line is traced in a very circuitous direction through the vale of the Eske, and up the course of one of its branches, which leads up to the summit of the moorlands, whence the line descends along another valley, till it falls into the course of Pickering beck, which river flows into the Derwent. The difficult nature of this country may be gathered from the fact, that the railway, within a distance of twelve miles from Pickering, has to pass over a summit, at Blakehoe Moor, of 520 feet; and that some of its inclinations, notwithstanding its circuitous course, are as steep as 1 in 28, and even 1 in 11.

The vale of Pickering has been already mentioned in connexion with this tract. It is a low, flat district, extending from Filey Bay to the westward, skirting the elevated land of Pickering forest, and the famous bone caves of Kirby Moorside, and thinning out on the sides of Hambleton hills. This vale has the Kimmeridge clay for its subsoil; and as this, together with the Oxford clay, which is very similar, forms an important part of the oolitic strata, and is, besides, intimately connected with a part of our subject relating to the mode of executing the slopes of clay cuttings, it may be proper to introduce some notice of them in this place. The Oxford and Kimmeridge clays, then, are deposits of almost uniform composition, and commonly average from 130 to 200 feet in thickness. They rest on the calcareous grits and freestones which have been already mentioned. A section of cutting through these clays commonly presents a face divided into innumerable small rhomboidal fragments, into which the clay freely splits in drying. The lower part of the clay is of a deep blue colour, and is commonly the most argillaceous. Towards the upper part it becomes more arenaceous, contains more iron, and gradually exchanges its bluish colour for a tinge of yellow. This yellow colour is commonly ascribed to the presence of iron, which, uniting with oxygen, becomes the yellow peroxide of this metal. Another effect of the presence of iron in this clay is seen in the composition of most of its fossils, both animal and vegetable. The tissues of these have commonly been replaced by iron pyrites, which is the sulphuret of iron, and gives rise to those numerous nodules, sometimes of a striated, but more commonly of a radiated texture, which are so constantly met with in excavations through this clay.

We may now proceed to another extensive tract of country, throughout which the oolitic formation prevails. Commencing at the Humber, to which we have already traced the oolites of Yorkshire, the same series immediately begins to widen out, its western boundary ranging by Lincoln, Grantham, Oakham, and Banbury, where its escarpment is broken through by the river Cherwell. Its eastern boundary extends from near Barton-on-Humber, in a south-easterly direction by Market Raisin, Horncastle, and Spilsby, south of which the whole formation has been extensively divided throughout the ancient estuary of the Wash. The outline of the upper oolite may be traced, however, on the eastern shore of the Wash, from Hunstanton, by Downham Market, to Ely, Bedford, and Aylesbury, to the vale of the Thames, which it crosses at the confluence with the Thames, about fourteen miles below Oxford. The district comprised within these limits has a breadth of about four miles at the Humber, and about thirty miles along the vale of the Thames and Cherwell at Banbury; while in the middle, where it occupies the counties of Norfolk, Cambridge, Northampton, and Rutland, it swells out to a width of not less than sixty miles. It must be understood, however, that the outline of the district here described is extremely irregular, particularly on the west side, where the valleys of all the rivers are occupied by long tongues of the lias, which toothes in, as it were, with the oolitic strata throughout the long line of its western limit. Commencing at the Humber, and proceeding southward on the oolites towards Lincoln, we trace a line of country principally composed of the Oxford clay and calcareous grits of the middle and lower groups. This district slopes down from beneath the wolds of Lincolnshire into the valley of the Aucholme, which intersects it from north to south, the river flowing into the Humber. The country also slopes rapidly down to the Aucholme valley from the western or escarpment side of the range, and numerous east and west streams are thrown off from the highlands, and find their way into the Aucholme on both sides of its course.

The transverse valleys on the east side of the Aucholme are favourable for lines of communication between the sands and limestones of the cretaceous system, and the heavy clays and grits of the oolite. The Caister canal flows in one of these valleys, and the Market Raisin canal in another. They both fall into the Aucholme navigation, which communicates with the Humber. Caister is situate on the green sand at the edge of the Wolds, and the canal which takes its name crosses the green sand and the Kimmeridge clay, and passes through a valley principally composed of the Oxford clay, parallel to the course of Kelsey beck into the Aucholme. The other transverse valley, in which lies the Market Raisin canal, is occupied by the principal feeder of the Aucholme, and consists, like the former, principally of the Oxford clay, with occasional strata of calcareous grit.

The extreme southern branches of the Aucholme rise about eight miles north of Lincoln, and very near the sources of these commence those of the old Witham river, which flows to the south-east, through the fens, into the Wash at Boston. Owing to the great height of the western escarpment above the flat lias country which lies beyond it, and to the insignificant depth of the small valleys by which it is furrowed from its summit into the Aucholme valley, it would be difficult and impracticable, except at an enormous expense, to extend the transverse lines of the Caister and Market Raisin canals across the intervening range, so as to reach the vale of the Trent. At Lincoln there is a great transverse gap through the whole range of the oolite. This gap is the valley of the Witham, which flows off the lias through the oolitic district into the fens. This remarkable gap is a physical feature of great importance to the whole surrounding country, as it affords that communication with the vale of the Trent and the central districts of England, which we have already said was impracticable at any other place between Lincoln and the Humber. By means of the Fos dyke navigation, which extends from the Witham at Lincoln into the Trent at Torksey, the whole fen country bordering on the Witham possesses a direct water communication with the Trent, and thence northward to the Humber, and southward to Nottingham and the great coal-fields and manufacturing districts of the midland counties. This valuable line of navigation through the fen district has been extended from the Witham up to the town of Horncastle, a distance of about eleven miles from the main navigation of the Witham. The Horncastle navigation is principally composed of the river Baine, which has been rendered navigable, and of artificial canal cutting off the bends. There are several other small rivers falling into the Witham, which might be made navigable in the same way up to the rich corn country which flanks the Lincolnshire wolds.

Through this gap at Lincoln it is that any line of railway, proceeding across the fen country from Cambridge to York, or Scotland, must necessarily pass in order to get upon the lias and new red sandstone district. In no other way can York be reached from the fen country, unless an extremely difficult line be traversed on the oolites north of Lincoln, together with obstacles so great on arriving at the Humber, that no engineer could think of encountering them when a passage so favourable can be had at Lincoln.

Accordingly, through this natural gap at Lincoln the Great Northern line was traced; but this railway, unfortunately for the agricultural interests of Lincolnshire and the east riding of Yorkshire, was rejected by Parliament on the second reading, without even that trial of its merits which many a more worthless project has had the good fortune to obtain.

The oolitic district from Lincoln to Stamford comes next in order. Here a great part of the clay country has been washed away by diluvial action, and has given place to the light peat of the fens. The subsoil of clay is commonly met with, however, on sinking a few feet into the ground. The oolitic strata which are still left *in situ*, however, occupy a district, with an average width of thirteen miles from Lincoln to Stamford.

In this district the clays are not so extensively developed as they are north of Lincoln, in place of which the grits prevail more extensively, and afford at Sleaford and other places valuable stone for building. Between Lincoln and Stamford the clay district has a gradual slope from the fens up to the high lands occupied by the more indurated oolitic strata. As far as Sleaford, the numerous streams which flow over the clay into the fens, take their rise just where the clay thins out upon the porous grits, and the sources of these streams define with tolerable accuracy the line of clay which draws up the water they contain. From Sleaford there is a navigation by means of canal into the river Witham, a distance of about eleven miles. This canal passes through the clay district, and exhibits some cuttings of no great depth through the Oxford clay. For about half the distance between Lincoln and Stamford all the streams make their way into the Witham, and as the valleys which run up into the high part of the range become very insignificant at some miles from the summit, it will readily be conceived that transverse canals or railways are here also impracticable.

At Stamford the river Welland flows through the range of the oolites, in a valley which is scarcely of less importance than that already mentioned at Lincoln. In this valley of the Welland an extensive denudation of the oolitic strata has taken place, in consequence of which the inferior strata of the lias are exposed even up to the verge of the fen country. If at some future time it should be thought desirable to unite the ports of Boston and Lynn and the adjacent fen country with the London and Birmingham railway near the latter terminus, a remarkably fine line for such a purpose may be traced up this Welland valley by Market Harborough and Stamford. This was in fact the line of country proposed for the Birmingham, Coventry, Boston and Lynn railway, a line which was abandoned for want of support from the Birmingham Railway Company. In consequence of the Northampton and Peterborough line, however, which runs through the nearly parallel valley of the Nene, for which an Act has recently been obtained, and which is now in course of execution, it is probable that the Stamford line will have no chance of revival for some years.

The oolitic country, south of Stamford towards Northampton, presents a remarkable configuration; and exhibits, in a greater degree than any we have yet considered, the tremendous effects of mighty floods which have swept over every part of its surface, scooping out innumerable valleys, carrying off immense tracts of land from the surface, and giving to view the deposits of still older periods. All the tortuous valleys, occupied by the numerous branches of the Nene and the Welland, expose a greater or less breadth of the lias clays and shales, which, in ages incalculably remote from the present, were no doubt covered by a vast thickness of the oolitic strata, now entirely wanting. In consequence of this extensive degradation and wasting of the oolitic rocks in this part of their course, there is a comparative ease in carrying communications through most of these valleys, and the main valley of the Nene itself affords an admirable line of levels from Northampton down to Peterborough. Eastward of this valley, which is entirely composed of the lower oolites and the subjacent lias, the oolitic country extends over a large tract in Bucks, Beds, and Hunts. This tract is principally the Oxford clay, with occasional limestones or imperfect marbles, and calcareous grits suitable for building.

Many large engineering works have been built of the native stones of this district, which are quarried in the neighbourhood of Bedford, Olney, and other places. The marble or shelly limestone is commonly the superior rock. It is principally used for burning into lime, the quality of which is excellent both for building and agricultural purposes. The lower rock is a free working grit of good quality for ashlar. These circumstances, relative to the economic geology of the district, are evidently of great consequence in designing and laying out any new line of communication, in which it is always important to know whence are to come the materials for building the bridges and other works.

We now come to that important pass through the oolitic country which has been adopted for the Grand Junction Canal; at a more modern period for the Great Birmingham railway. Some of the principal works in both of these great projects occur in this part of their course, and here too some of the finest displays of engineering skill are to be met with; as, for example, in the great Blisworth tunnel on the canal, and the deep rock-cutting, with its immense extent of under-pinning, which occurs on the railway in the same neighbourhood. The valley through which these works are carried is occupied for about half its length by a branch of the Nene flowing in a north westerly direction; and for the other half, by the main stream of the Ouse, and one of its branches flowing in a circuitous course, which has been more closely followed by the canal than by the railway.

There is a summit of country to be passed over in emerging from the basin of the Nene into that of the Ouse, and at this summit are the principal works on this part of each line. It is evident that this pass, presenting as it does much greater obstacles than some others through the oolitic country, would never have been chosen, were it not that the position of London, with reference to the mineral and manufacturing districts of the Midland Counties, imperatively required that a passage should be made somewhere in this direction. Stamford on the one hand, and the Cherwell valley on the other, through which the Oxford canal is carried, would have been too circuitous; and hence a vast sum of money has been expended in forcing, through the most unfavourable passage of the three, a great railway and a great canal, each entitled to rank among the foremost of its class, and each claiming, by reason of its magnitude and importance, something of a national character.

The country beyond this valley, towards Oxford, exhibits an elevation considerably greater than that on the other side of the valley. The indentations of the lias are less frequent, the prevalence of the oolitic rocks is more continuous, and the streams take their rise from the minor valleys of the oolitic country instead of forcing their way through from the older formations.

There is, therefore, no available pass through this part of the range, and no physical feature requiring particular notice, till we come to the valley of the Cherwell, which is a considerable river, rising from the marls of the lias, and passing through the oolites in the direction of Banbury, Somerton, Kirklington, and Oxford, where it falls into the Thames. This valley, as already mentioned, is the line of the old Oxford canal, a work executed by Brindley, and subsequently much improved under the directions of Telford and other engineers. It passes through a good deal of the material already mentioned under the name of the Oxford clay, and has also caused some excellent quarries to be opened on its banks, where it intersects the lower oolite near Kirklington.

Art. X.—PAPERS OF THE ROYAL ENGINEERS.

Papers on Subjects connected with the Duties of the Corps of Royal Engineers. Vol. vi. London: Weale. 1843.

This is an elegant and portly quarto, most profusely illustrated with plates. The plates are, indeed, so numerous, that it is difficult to determine whether we ought to say, that the plates illustrate the letter-press, or that the letter-press is explanatory of the plates. Both are executed in the first style of art, and amply sustain the publisher's high character for elegance and accuracy in the execution of the numerous mechanical and scientific works that issue from his establishment. We hope that the Royal Engineers will take no offence at our thus noticing the publisher before the authors, but the truth is, that in our eyes the principal value of this work consists in its numerous and excellent drawings of works already constructed; and these, in so far as the contributors are concerned, are mere copies—the contributors, merely mechanical draughtsmen, so that they ought not to find fault if the merits of the engraver and printer are put on a par with their own. Having said thus much on the relative merits of the "papers" and the accompanying drawings, we shall endeavour to describe as briefly as possible the general nature of the subjects treated of.

The title of the volume would scarcely enable *un*professional persons to guess at the contents. Such persons might be apt to imagine, that the "professional papers" must be entirely on the noble art of war, or the multiform contrivances that science and ingenuity have supplied to the belligerents of this favoured age for defending themselves and destroying their enemies. Such persons would scarcely expect to find here, no less than ten elaborate plates of machinery for sawing timber, and still less, perhaps, detailed drawings of the heating and ventilating apparatus of the Reform club-house; yet these, according to the papers before us, both fall within the scope of the duties of the Royal Engineers. However unexpected this extensive range of subjects might appear to civilians like us, it is productive of at least one advantage; it enables us to classify these papers in two divisions, the first comprising those that are strictly connected with military affairs, and the second, those that appear to us to be of a purely civil nature. On the first of these divisions, we do not propose at present to give any analysis, and shall only indicate, for the information of our military readers, the principal papers that fall within the division. These are:—"On the Field Equipment of the Engineer department of the Army of the Indus, by H. M. Durand, Bengal Engineers."—"On the Defensive Works of Jellalabad, by Major-General Sir Robert Sale, K.C.B." Pretty voluminous notes on the coast defences of Syria, principally on the fortifications and sieges of St. Jean D'Acre, by Lieutenant-Colonel Alderson, Royal Engineers. This paper is profusely illustrated with plans, and views of the various towns and fortifications described.

We come next to the second division, or that in which we classify those papers that treat of civil affairs; and the papers of this class are much more numerous than those of the former. We do not propose of course to enumerate, much less to criticise, the whole of these papers. We shall notice, and that as briefly as possible, two or three of those that appear to us the most interesting or important. We are inclined to give the precedence in this respect to a paper by Lieutenant Hutchinson, of the Royal Engineers, on the operations in blasting the Round Down Cliff, near Dover, in January last. Our readers are all acquainted with the general nature of these operations, which excited so much interest at the time. They were primarily designed by Mr. Cubitt, the engineer of the South-Eastern Railway, and were undertaken with the view of removing a large chalk cliff that interrupted the progress of that railway along the sea-shore. Mr. Cubitt seems, himself, to have had the principal merit of placing the charges of gunpowder, and determining their magnitude so exactly, that they precisely accomplished the work proposed, and no more; but as the only way of firing these large charges of powder was by means of galvanism, he applied to the Ordnance department for the assistance of some of those officers and men who had acquired practical experience in this application of galvanism in the sub-marine operations against the "Royal George." In accordance with this application, Lieutenant Hutchinson was appointed to superintend the preparation of the batteries and wires and the firing of the charges. These were three in number, fired simultaneously, and consuming in all 8½ tons of powder, the *débris* from the explosion covering 15½ acres of ground. This gigantic blasting operation seems to have been managed from first to last with great ability and success, and, as Lieutenant Hutchinson remarks, was "the most extensive in the means employed, and successful in results, of any ever undertaken, or recorded in the annals of history." The full details of the operations, and drawings of the apparatus and works, will be found in Lieutenant

Hutchinson's paper. We shall only remark here, that the rule by which the magnitude of the charges was determined was, that the weight of powder, in pounds, should be one thirty-secondth of the cube of the line of least resistance in feet. This is precisely the sort of paper that is the most appropriate in such a volume as that now before us. It is a plain record of important facts, established in actual practice, and well fitted to guide engineers in future operations of the same kind, and of which, at least on such a scale of magnitude, we had no previous experience.

The next paper we shall notice is of a very different kind from the last. It is not a short account of new and important practical facts, but a rather long-winded "practical essay" on some very old facts, which have been much better treated of a hundred and one times before. We allude to a paper entitled, "Practical Essay on the Strength of Cast-iron Beams and Columns," by William Turnbull, which in point of size is *the* paper of the volume. This Essay is a compilation, and a clumsy and useless one, without one new fact or new idea, but a vast number of old ones, most of which are now, and have been some time since exploded. It is, nevertheless, a composition which must have cost its author a good deal of labour, and we cannot but regret that he should have spent his time to so little purpose. Mr. Turnbull's method of calculating the strengths of beams, whose sections are not simple rectangles, is not perfectly correct in principle, and will sometimes lead to results much further from the truth than he seems to suspect. But independently of this, those forms of beams which he has described are all discarded now in the best practice. All his beams have very strong webs with comparatively light top and bottom flanges, and these flanges are generally of the same strength at the top and bottom side of the web. Now, it has been clearly proved by Mr. Hodgkinson, and acknowledged by universal practice, that the most economical form of section, for a cast-iron beam, is a thin web, very light top flange, and a very broad and heavy bottom flange. For calculating the strength of this section of beam Mr. Turnbull has provided no rule, either good or bad; yet, strange to say, the editor seems to have been aware that this was the most approved shape. The following is rather a choice sentence. "In taking the forms of the girders as given by Tredgold, and calculating the tables by his rules, I have not lost sight of the experiments made by Mr. Hodgkinson, which appear conclusive in favour of increasing the width of the bottom flange in cast-iron beams; but, as I am not aware that the results of these experiments have been embodied in a form susceptible of calculation, I have thought it better not to delay the publication of the present tables." Mr. Turnbull, it seems, had compounded an essay, and although Mr. Hodgkinson's experiments unfortunately rather marred its utility, it would never have done to deprive the world of so ingenious a production, merely because it was useless. Above all, if it had been dismissed, how would the requisite number of pages have been got for Vol. VI. of the "Professional Papers?" These are strong reasons, certainly, for the publication in this book-making age; but what shall we say of the modesty of the following proposal? "Admitting, therefore, that the proportions as specified for each of the above forms of section, (Mr. Turnbull's forms of section,) are the best that can be chosen, we see no reason why they should not be universally adopted in the construction of cast-iron beams." It was surely enough, that Mr. Turnbull should inflict his Essay on the public in defiance of Mr. Hodgkinson, without at the same time asking them to use his section of beam in defiance of the same authority, and solely that his tables and rules might be dragged into service. We observe, in the commencement of this Essay, an error into which the authors of "practical" essays are very apt to fall. "Practical" essays are, of course, intended for practical men, and as these are supposed not to be in general profound mathematicians or algebraists, it is thought necessary to omit as far as possible the use of these sciences. On the other hand, something in the shape of a demonstration, or a mathematical diagram, is needed to give the essay a smack of science and profundity. These two objects are, unfortunately, rather incompatible; and, accordingly, Mr. Turnbull, in a vain attempt to be scientific and popular at the same time, has given some so-called demonstrations, which have no other resemblance to demonstrations than that they bear the name, or assume the form, without the power. For example, he *proves* that the strength of rectangular beams is in proportion to the square of the depth. Thus, he *supposes* that the strength of one beam is represented by the area of a triangle A, and that the strength of another beam, twice the depth of the former, is represented by the area of a triangle B; and as he has taken care to make B exactly four times the size of A, it immediately follows that the larger beam is four times as strong as the smaller!

Our remarks have already extended to too great a length; we therefore take leave of this volume by remarking, that those who may feel interested will find in it very complete drawings of the saw-mills at Chatham dockyard, of the American steam pile-drivers, of various very good iron roofs, and of several other useful constructions. On the whole, the drawings, as we have already remarked, are the best, part of the volume: the articles generally are mediocre.

ART. XI.—THE GERMAN SCULPTORS.

It is somewhat difficult to write upon sculpture without indulging in speculations that are, at least, perplexing, and often fanciful. The senses are struck at once by the distinction that subsists between the works of the sculptor and those of the painter. Reason, or rather, reasoning, shows that the operation of both on the human eye is necessarily pictorial. The question, therefore, presents itself, even to the least reflecting of those who strive to account for their own emotions, why it is that the picture which is thrown on the retina by mere form and mass, affects the mind so differently from that picture which is impressed on it by mere colour and surface. This problem, thus announced, has more than once been put forth as the answer to the very question which it involves; it must be felt, however, that an enumeration of the means by which two distinct effects are produced, is not an explanation of the cause why those means do produce different effects. The real answer lies within the domain of metaphysics, and for that reason, whatever his chance of success, the writer of this paper will not attempt to furnish it; he may observe, however—and this will serve as an excuse for his having drawn attention to a theme which he does not intend to treat—that an account of a school of sculptors, which is not based on a satisfactory solution of this problem, must of necessity be incomplete, superficial, and, at best, historical only.

When from the primordial moulds of architecture, that mould which is common both to painting and sculpture, there issued the statue, the living figure complete in itself, an event took place in the world of art, similar to that which was witnessed in the world of reality, when man, free and master of himself, emerged from the bosom of nature. In the one as in the other creation, form, in the highest degree of abstraction and power, disengaged itself from the envelop of matter and the vague depths of space. Painting, which is the common offspring of architecture and sculpture, is involved in relations more complex, and has ever remained in a state of dependence, which the fictions of art have been unable to conceal. Now sculpture being, of all others, the art of form, has, for this very reason, always been difficult of access to the German race. We may account for this, compendiously, but not the less truly, by observing that the Teutonic migration was accompanied by the system of oriental pantheism; a system which, in multiplied diversities of form, and varying with every phase of human circumstance, is peculiar to the German mind, and seems destined to reappear at the completion of each cycle in its intellectual existence. This system merges all distinctions of form in the mysteries of a unity eternally changing and eternally persisting. The monuments that have been bequeathed to Germany by the remoter epochs of the middle ages, show no traces of national sculpture capable of rivaling in originality or power the schools of painting that then flourished in that country. The sculpture of the Byzantines, that of the French, that of the Italians, each in its turn, has exercised an influence almost sovereign over the ancient confraternities of German artists. The revival, indeed, gave to some of those who succeeded the ancient statuaries a certain particularity of character; but it was not national, and the artists themselves remained, in their sphere, far behind their countrymen who achieved immortality by labours of the pencil. Looking then at what was done of old, the conclusion would be irresistible that a German sculptor will have more trouble in overcoming the difficulties of his art, and gaining celebrity, than will a German painter not his superior in talent.

The most celebrated sculptor that the Teutonic race has produced in our times, is Albert Thorwaldsen, who was born at Copenhagen on the 9th of December, 1770. By his father, who was an Icelander, by his mother, whose pedigree is traced back to King Harold, he belongs to the most ancient stock in Scandinavia. At an early age he devoted himself to the study of antiquity, but with a peculiar and melancholy sentiment, such as might be expected in one who had to surrender the traditions of Odin, and the sons of Asia, to the civilisation of Christianity and the genial taste of the Greeks. After having studied and laboured for some time in Denmark, he went in the year 1797 to Rome, where he met with a fellow-countryman at the height of reputation and fortune. This was the archæologist Zoëga, the pupil of the celebrated Heyne, the man who first placed on a solid basis the study of Egyptian antiquities. Under his advice, and under the influence of the works of Canova, who was then at the summit of his glory, Thorwaldsen began that laborious career which has been crowned by the presidency of the Academy of the Fine Arts of St. Luke. Although he has never wholly departed from the principles of antiquity, yet are there to be observed, in the numerous works which he has executed since the commencement of the present century, and which are distributed over all the countries of Europe, evident traces of the two great epochs in the development of German art, to which we recently drew the notice of the reader, and which the names of Mengs and Overbeck represent. His works have been engraved and published in Germany, with a most valuable commentary by M. L. Schorn.

Now, and not without being conscious of the risk which he is running by the avowal, the writer is of opinion that the works of Thorwaldsen which he has seen, are below the engravings from them, and also below his reputation. The execution appeared to him to want fervour and emphasis; the taste was at once indulgent and formal, the work symmetrical and mellow, showing more patience in polishing than in modelling, more ability in fashioning the clay than in managing the chisel; worst of all, the hands of pupils—and the Danish sculptor has but one of any superioity, Tenerani—were to be seen. Though they always show study, and often research, the principal inflections want that profound and daring character of which the hieratic handwriting of the early monuments of art contains the germ and the seed. On the other hand, the care bestowed on the secondary sinuosities correct, to a certain extent, the timidity of the decisive angles. The conception of the forms is superior to the execution; never trivial, it is also never conventional; if now and then it does not rise above mediocrity, the mediocrity is neither facile nor commonplace: it is not distinguished by grandeur in generalisation, or even of style, but it is true to the personal genius of the artist, and appropriate to the subjects which he treats. The composition, which is always the finest part of his works, is marked by opulence of ideas, by the monumental sobriety with which they are rendered, by the noble ease of the groups, by the sweet and elegant simplicity of their distribution. Thus the expression, which is a great merit in sculpture, results almost entirely from the arrangement.

Among the works in which Thorwaldsen has employed both the forms and the principles of antiquity, the group of Ganymede giving drink to Jupiter's eagle is remarkable for the happy contrast between the terrible physiognomy of the Olympian bird and the smiling face of the young man. The bas-relief which represents the night visit of the boy Love to Anacreon, exhibits another and most charming pair of apposites. The groups of Bacchus pouring out wine for Love, and Venus playing with her son, display, on the other hand, a profound study of the divers phases of grace. At the commencement of his career the Danish artist bad executed several bas-reliefs on scenes from the Iliad, informed by a sentiment at once so simple and so elevated, that his success in this range of art was not difficult to predict. Napoleon, who appears always to have been the confidant of destiny, gave him, in 1811, a commission for a grand frieze, on the triumphal entry of Alexander into Babylon, the execution of which was interrupted by the fall of the French empire. The Count Sommariva put himself in the emperor's place; the work was completed, and it now adorns his villa at Tremezzo, on the margin of the lake of Como. Thorwaldsen has executed two copies of this work, one in stucco, for the Quirinal palace at Rome; and one in marble for the castle of Christiansburg, a residence of the King of Denmark. The rich imagination of the author displays itself therein, by a skilful diversity of attitudes, of costumes, and of groups; by a familiar interpretation of ancient life; and by certain harmonies peculiar to modern poetry. A comparison of this with his other performances leads to the conclusion that the immortality of Thorwaldsen will rest on his bas-reliefs. In the centre of the composition, on a chariot drawn by four horses, the reins held by a winged figure of Victory, Alexander advances full of his glory, and of an emotion more religious; behind him a Phrygian is loaded with his buckler and lances; a Thracian bears his bow and arrow, and two slaves lead Bucephalus, who bounds with pride; generals of different ages and character follow; then comes the cavalry of all arms, after which march the footmen, who seem weary from having traversed so many countries; this part of the procession is closed by an elephant, which carries, with head depressed, the rich spoils of Asia, and a captive king, by the side of whom the artist has represented himself contemplating, with deep emotion, this spectacle of human misfortune. Returning to the central point of the frieze, we see a winged figure of Peace, which, with an olive branch in hand, pauses before the car of Alexander; behind her, the military chief of the subject city, wearing the guises over his eastern habits, leads his children to the conqueror; his servants carry his arms, which they weep to behold inactive; his wives strew flowers before the victor, and shed tears for their country; the chief pontiff causes to be fixed, to the sound of sacred instruments, the tripods on which he is about to sacrifice for the new king; men are seen leading and checking the horses that are to be offered to the Macedonian; children bring to him chained lions and tigers; at the gates of the city the old men and magi comment sadly on ancient prophecies, mothers press their babes to their bosom; beneath the ramparts, beyond which are to be seen the temples, the houses, the gardens, the inhabitants, a shepherd drives in the flocks destined for the altar; in a spot remote from the ramparts the genius of the Euphrates rests gravely on his urn, by the side of his waters; then a barque transports along the tranquil stream the rich exchanges of commerce; finally, the calm continually increasing, a fisherman is seen on the other bank, withdrawing from the water his line bent by the weight of a small fish, while his dog silently scents the solitude of palms that opens behind him. Thus are crowned, with a charming familiarity proper to apologue, the epic pomps of this great composition. Is not this the genius of Beethoven dealing with other materials?

The tendency of Thorwaldsen's mind towards meditation on fanciful themes induced him to take a share in those studies of which, at the commencement of the century, Christian art was the object. At Rome he protected the romantic Germans by his rewards and by his sympathies. The trace of their ideas is impressed on the works which he has executed for the portal of the cathedral at Copenhagen: the statue of Christ, the principal piece, bears evidence of a desire to accommodate the Byzantine type to the forms of classic sculpture. In the figures of the apostles and prophets which accompany that of the Saviour, and in which the same system is rather less apparent, the expression, at one time too civilised and at another too credulous, betrays a mind that knew not how to ally dignity with faith. In composing these works, Thorwaldsen has changed the adjustments rather than the principle of his earlier manner; he did not seize on the radical element of the forms of the Middle Age, and so lost the opportunity, which seemed made for his genius, of restoring them to statuary, as Overbeck has brought them back within the domain of painting. That the sculptor has not succeeded in this undertaking, is no fault of his mind, which is full of resources and intelligence. Had he been more skilled in the great art of execution, he would have sought to penetrate more deeply into the principles of divers systems; instead of composing, as is his custom, puny sketches, which he delivers to the blind instincts of his workmen, he would himself give to the clay the profound and exalted forms that should prepare the substance on which the hand of a master is to be employed. In art, at all events, the most intellectual qualities are essentially united to those which are most positive.

Another northern artist, a Swede, residing at Rome, has shown, within the last few years, great powers of execution, informed by the purest taste for ancient forms. He was born at Gottenburg, in 1786, and when still a young man was admitted into the Academy of Stockholm, in which city he received his first lessons in art. His notions of sublimity were so much at variance from those in favour with that corporation, that he was offered a pension on condition of spending it in foreign countries. He first went to Paris, where he spent some time in the studio of the painter P. Guerin. From Paris he betook himself to Rome, where he soon formed an intimacy with Thorwaldsen, of whom he has always expressed sentiments of sincere and honourable admiration. A Psyche, the first work which he executed in Italy, exhibited some marks of the style adopted by the Swedish sculptors who had sent him into exile; but antiquity soon exercised its rights, and subdued his mind. A Mercury throwing Argus into a sleep, which was the subject of a noble rivalry between him and Thorwaldsen; Cupid stealing the arms of Mars; Cupid bending his bow into a shell; marked his first steps in a new career. Paris holding the apple of discord, elicited unanimous applause, and, after long years of oblivion, drew the attention of the Swedish government to its pensioner. These last performances, in which is to be traced a continuous progress in elegance and subtilty, are modelled on the most exquisite relics of Greece; they aspire to that learned grace which was taught by Praxiteles, whom, despite the revolution of taste in the present century, Fogelberg prefers to Phidias. This is a feature by which the Swedish sculptor will be recognised by those who for the first time see his beautiful marbles. He makes no account of the grand system of lines which, in hieroglyphic epochs, the human mind imposed on nature to mark the freedom of its own thought. Neither does he so far submit to matter, as to be its slave. He practises the delicate, complex, and, as some may think, the corrupt art of those times in which men preferred the pleasures of the senses to the enjoyments of the intellect, in which the artist was compelled to abandon the great linear traditions and significant inflections, and seek for success in the skilful balance of parts, and the graceful sweet of voluptuous situations. Fogelberg submits, with an atticism peculiarly his own, to the necessities of our times; he gives to decline, the knowledge that compensates degretion, and the purity which ordinarily it excludes. Two figures which he has lately sent to Sweden, an Apollo Citharædus, and Venus receiving the apple which has been offered to her by Paris, are considered models of refined and correct beauty. In the statues of two kings of Sweden, Charles IX. and Gustavus Adolphus, the artist has succeeded in adapting the antique style to the character of modern times. In a colossal figure of Odin he has raised himself, by an effort unforeseen yet natural, to energy and grandeur; though he has dallied with the Belvedere Apollo, the child of the North has not looked without emotion on the grand outlines of Albano, and the austere lineaments of the Campagna.

Of the sculptors to whom the north of Germany was a home, Godfrey Schedow must be mentioned first. He was born at Berlin in 1764, studied his art at Vienna, and went to Italy in 1785, where he remained two years. He then returned to his country, and was eventually honoured with the Presidency of the Academy of the Fine Arts at Berlin. Two statues on the Wilhemsplats, erected by him in memory of two Prussian warriors, are worthy of notice, solely from their being at least a half century behind any other work of modern art that has been deemed worthy of such an honour.

Christian Rauch was born at Arolsen, in the principality of Roaldeck, in the year 1777, and received his first lessons from a sculptor attached to that little court. At the age of twenty he went to Berlin, and met with powerful protectors, who enabled him to visit France, and afterwards Rome, where he studied both under Canova and Thorwaldsen. In 1811 he was recalled to execute the monument of the Queen Louisa, who had just died, and after some time he returned to Italy, with the intention of modelling in that country the figure for the tomb. He found matters much changed: during his first sojourn he had seen antiquity reappear in forms the most exact and subtile; when he again passed the Alps, Cornelius and Overbeck had undertaken the restoration of the harder and bolder forms of Christian art. He had formed his mind during the preceding period; but he was not insensible to the impression of its successor. The works which he has executed under the combined influence of the two periods, are distinguished by the grave elegance that marks the person of the artist, by lofty stature, nobility and grace of demeanour, happy and sustained emphasis, and all those properties which bear testimony to a mind for which nature has done more than education. The figure of Queen Louisa which adorns the monument at Charlottenburg is a beautiful portrait, composed and modelled on the principles of antiquity, but betraying nevertheless the depth of the emotions under which it was formed. The six winged figures of Victory that adorn the interior of the Walballa, are designed with more freedom, and executed with more warmth, but, in their essential features, bear a strong resemblance to the earlier mythological compositions of the master. Two beautiful Danaids, executed for the Emperor of Russia, are informed by a sadness that mark a more profound feeling of antiquity. Rauch was born to feel and practise the loftiest work of sculpture, that which represents man in the pure nakedness of his form: yet he has been doomed to spend the best part of his life in carving, for the public squares of Germany, portraits disfigured by the costume of our time. He has erected at Berlin, in front of the guardhouse designed by Schinkel, three statues, which might teach some critics at home that the happiest inventions and richest resources of art are nothing if they be not supported, in the mind of the spectator, by a superior and impalpable order of sentiments. The statues represent Scharnhorst, Bülow and Blücher.

Between the first two there is a happy contrast, Scharnhorst all calm, Bülow all movement; they are in Carrara marble. The figure of Blücher, cast in bronze, is in an attitude of daring, appropriate to the name and the features; holding a naked sword in the right hand, and planting the left foot on the mouth of a cannon, it seems to put an end to war by war itself. These figures seem to wear unwillingly modern costume, to so great extent has the artist allowed the natural forms to penetrate through, not only the folds of the drapery, but the very tissue of the stuff. The base of each is described with bas-reliefs, that display power and inventiveness akin to those of Thorwaldsen. On one of these pedestals a figure of Victory, with brandished lance, urging on a lion to the combat, exhibits a nobility of forms and animation of lines that challenge the warmest admiration. A complete poem, remarkable for the variety and excitement of its episodes, full of spirit and exquisitely natural, rolls round the socle of Blücher's statue: it is the poem of Germany's liberation. Many traces of the influence of the romantic school are visible in these bas-reliefs; it is predominant in the more recent performances of the artist. A bronze statue of Albert Dürer, erected about two years ago on one of the public squares of Nüremburg, recalls the sentiment that animates all the pictures of that master. The recollection of the art of the middle ages is still more strongly impressed on a beautiful group in bronze, which the Count Raczinski has presented to the cathedral of Posen. It represents the first two Christian kings of Poland, Miceslas and Boleslas. The difference of character is admirably portrayed: the father, the former, with the insignia of a divine mission in his hands, holding, instead of a sceptre, the cross, with which he was commissioned to give empire over the Sclavonians: the son listening sullenly to the lessons of the old man, and shaking, with convulsive grasp, his sword, his supreme law.* These two figures, full of profound humour, are marked by an individuality of mintage peculiarly Teutonic; the embroidery and bands of the costume incrusted with jewellery after the fashion of the Byzantines, give them all the appearance of antiquity. The great work of Rauch's life is the equestrian statue of Frederick the Great, not yet completed we believe. When the commission was given him he proceeded to St. Petersburg, to study with a German artist in that capital, renowned for the fidelity with which he executes the figures of horses. On his return, he instituted a comparison between the forms which nature creates, and those which Phidias has bequeathed to posterity, and, combining them, he produced the horse that is destined to bear the figure of Frederick in his historic costume. He prepared two designs for the pedestal, that show the phases of his art: the one learned, elegant, and cold, with four noble figures adorning the corners; the other, leaving more scope for movement and daring, represents horsemen issuing from each angle of the socle, and filling up with various dramatic groups, in haut relief, the four sides. To the regret of the sculptor, the first was preferred. Of the works which the author has modelled only, those that are the most dear to him are the more remote from the forms and principles of antiquity. There is a little group, celebrated in Germany, in which he has represented the subject of an old Saxon tradition, a young girl, who has lost her way in the forest, brought back to the castle of her father. To see this executed, if not by his own hands, at least by one of his pupils, is said to be the darling wish of this great man. A young man formed under his tuition, Kiss, has exhibited at Berlin a group of an Amazon struggling with a panther, that shows him qualified for the task.

Christian Frederick Tieck was born at Berlin on the 4th of August, 1776, and occupies among the artists of that city a high position, for which, however, he is more indebted to the qualities of his mind than to his talents as a sculptor. Educated towards the close of the last century in the school of Schodow, he travelled in Italy with Rumohr and his own brother, the great author. In such companionship he seems, as indeed was natural, to have thought more of criticism than of the practice of his art. Before returning to Germany, he resided for some time at Coppet, where, as is well-known, conversation reigned supreme. He, however, made some busts, and received advice that confirmed his preference for a style, of which, it cannot be doubted, all the rules were fully discussed. He returned to Berlin in 1819, and after a few years was made Inspector of the Hall of Sculptors in the museum. Chiefly esteemed for judgment and taste, and the minute fidelity of his busts, he has done little either in the ancient or the romantic style. A figure of Christ which he modelled for a church in Silesia belongs, strictly speaking, to neither.

A young sculptor of Dresden, Rietschl, appears destined to effect that alliance between ancient forms and modern sentiment which, on a former occasion we remarked, was the day-dream of Carstens. The pediment which he is now executing for the theatre of that city, presents traces of this happy combination. The subject is Aristotle's definition of tragedy: he has written it in the language of the ancients, commented on it in the spirit of our own times. To purge the passions by the emotions of art, to subject the disordered forces of the soul to the harmonious laws of beauty, is the thought which he has expressed by force always noble, by attitudes full of pleasing freedom. At one extremity of the pediment, Sacrilege, the violent passions, are represented by a priest struck down at the foot of the altar, by parents who weep over the death of their son; the Furies excite their grief, and pursue the criminal, who throws himself in despair at the feet of Minerva. In the middle of the pediment, Melpomene presents her troubled mask to the Eumenides, and turns a calm visage to the other side, where Minerva is leading her suppliant to three august old men, the fathers of Greek tragedy, seated as judges, but full of benevolence, and extending their arms to receive the unhappy one. Behind them, the sword drawn in anger re-enters the sheath; and man employs, in the subjugation of nature, that energy which of late he turned against his fellows and himself. This pediment, although executed in bas-relief, reminds the spectator, by the diversity of its lines and the sobriety of its forms, of those famous statues which filled the pediment of the temple at Ægina; and which, now deposited at Munich, have developed in that city, as well among the learned as among artists, a spirit of romance truly Greek.

Of Faunecker and Schwanthaler, on another occasion.

ART. XII.—THE SOCIETIES.

Royal Society.—The anniversary meeting was held on the 30th of November, when the two gold medals were awarded to Professor Forbes and Professor Wheatstone; to the former, for his paper "On the Extinction of Solar Rays;" and to the latter, for his invention for measuring the force of electric currents. The officers and council for the ensuing year were elected, or rather re-elected, with a few additions.

Society of Arts.—A paper, by Mr. H. K. Dyer, on metallic sand as a valuable adjunct for hydraulic cement, was read on the 29th of November. The copper slag, in the neighbourhood of Swansea, is ground, by powerful machinery, into the form of metallic sand, the component parts of which are, iron, zinc, arsenic, and silica. Its properties are similar to those of mine-dust, the adhesive qualities of which, in cement, have been long known; and the iron, which predominates, is supposed to constitute the most valuable part of its cementing action. Different specimens of the cement, made with blue lias lime and the metallic sand, and employed as surface-coating, were produced, some of which, after eight years' exposure to the atmosphere, retained all their original freshness and sharpness. A vase, also, manufactured of the cement, was shown, the ornaments of which preserved their pristine appearance, though it had been exposed to the action of the atmosphere for many years.—The endless expositions, by Mr. Dircks, of the merits of Mr. Williams's smokeless furnace; and, by Mr. Chanter, of his competing furnace with moveable fire-bars; have been inflicted on the Society at two successive meetings.

Zoological Society.—At the meeting of this Society in their new rooms, in Hanover-square, on the 23rd of November, a communication from M. Gamal announced the failure of arsenical preparations in the preservation of zoological specimens. It appears that after a space of three years the arsenic loses its effect. M. Gamal now recommends salts of alum as a preservative against the effects of time, and nux vomica as a protection against insects.—Professor Owen gave some account of the remains of the gigantic birds of New Zealand, in addition to the description with which he gratified the general meeting of the British Association at Cork, as noticed at the time in the ARTIZAN. Some additional bones have been since received from New Zealand, which have enabled the Professor to distinguish among them the relics of five species of the same kind, to which he has given the generic name of *Dinornis*, from its gigantic proportions. The largest of these species, it is now computed, must have stood ten feet high, and not sixteen feet, as originally supposed; and the others diminish, till the smallest is not larger than a common bustard. The apteryx, a bird still existing in New Zealand, which resembles the Dinornis in general character, is not half the size of the smallest of the species to which the discovered bones appertained. From the freshness of the bones, which contain much animal matter, it is thought probable the Dinornis may still exist in the unexplored parts of the island.

Ashmolean Society.—Some curious facts and speculations respecting the cure of cretinism, and the cause of that peculiar malady, were announced by Professor Daubeny at the meeting of this Society on the 6th of November. Professor Daubeny is of opinion that the disease is not occasioned by the quality of the water, as is generally supposed, but that it is produced by some form of malaria peculiar to the low Alpine valleys. An institution for the cure of this dreadful disease has been established near Interlachen, at an elevation above that wherein the malady is ever known to be endemic. No confirmed case of cretinism is attempted to be cured, but only those cases in which the disease has commenced to develope itself. The mode of treatment is by stimulants of all kinds, both physical and moral. It is estimated that there are not fewer than 5000 cretins in Switzerland.

Geographical Society.—Some interesting communications from Dr. Beke, relating his travels in Abyssinia, were read at the meeting on the 13th of November. Dr. Beke has visited many parts of Abyssinia not described since the days of Bruce; and he penetrated into some districts where no white man had been previously seen. Many parts of the country he describes as being cultivated and populous. In the plains and valleys are towns and numerous villages, and the general prospect of the country in these favoured districts gives, "in the cool of the morning, the idea more of an English than of an African landscape." The appearance of Dr. Beke at Chughai, in the district of Matakkel, which is inhabited by Shankalas, or pagan negroes, produced a complete "sensation," as no white man had been seen there before. It was market-day when he presented himself to the astonished inhabitants: " the negroes, in particular, exhibited signs of the greatest fear at my presence; five tall, muscular men, armed with spear and knife, hurrying away, and hiding themselves among the bushes as I approached. They wore no clothing; having merely a narrow thong of elephant's hide round the waist, in which the knife is stuck, and another, made of the bark of trees, passing between the legs."—At the meeting on the 27th of November, a communication from Mr. Baily, of Guatemala, was read, on the communication by canal between the Atlantic and Pacific Oceans. Mr. Baily prefers the line by the lake Nicaragua and the river San Juan. Though the land is higher, it can be easily excavated; and the river San Juan, he conceives, may be rendered navigable without much difficulty.

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* Boleslas was the more popular of the two. The exquisite Latin elegy on his death, by Martinus Gallus, is still popular in Poland. We quote the opening stanzas, for the entertainment of the classical reader:—

> "Omnis ætas, omnis sexus, omnis ordo, currite!
> Bolezlavi regis funus condolentes currite,
> Atque mortem tanti viri simul mecum plangite!
>
> "Eheu, eheu Bolezlave! ubi tua gloria!
> Ubi virtus! ubi decus! ubi rerum copia?
> Satis restat ad plorandum; væ mihi Polonia!"

French Academy of Sciences.—In the sittings on the 13th and 20th of November, papers were read by M. de Ruolz and M. Rousseau, on the substitution of the oxide of antimony for white lead in painting. M. de Ruolz asserts that the oxide of antimony is superior, in all its properties as a paint, to white lead; that it is more pure in colour; that it forms an unctuous and cohesive mixture with oil; that, when dry, it preserves its brilliancy; that it is superior to white lead as a coating to wood; and that, when mixed with other colours, the effect is far superior; and that it is also two-thirds cheaper. The use of oxide of antimony is said to be not prejudicial to health. This is an important consideration; for the effects of white lead is so prejudicial, that, in one hospital alone, in Paris, about 100 patients are annually received who have suffered from this cause. It is proposed to prepare the oxide from the sulphuret of antimony, which is abundant; and the paper communicated by M. Rousseau, had reference to an improved mode of decomposing the sulphuret of antimony and other sulphurets. The plan he proposes, is to pass a current of air impregnated with aqueous vapour, over the sulphuret when heated in a furnace. Part of the oxygen of the water-vapour thus combines with the metal, to form the oxide, and the sulphur escapes as sulphurous acid gas. This method of desulphurating the ores of metals is recommended as being attended with many advantages over the common process of roasting; and, by its adoption, it is expected that many of the poorer ores, which are now thrown away, may become well worth reducing, either for the value of the metal, or for the sulphur which they contain.

Art. XIII.—INVENTIONS OF THE MONTH.

Water-plate Steam-boilers.—A patent has just been specified for a steam-boiler, in which the water, instead of being divided by tubes, is separated by plates, which pass through the centre of the boiler. The flues in the boiler consequently resemble wide slits, and they are placed perpendicularly. More than half the water-space of the boiler on each side is left without flues, for the purpose of maintaining the water on the outside at a lower temperature than the inner portion, through which the flues pass. The object of this arrangement is to produce a constant and brisk upward current of water through the sheet water-spaces, for the prevention of saline deposits in marine boilers. The inventor, Mr. James Johnston, states that in his boiler the water-spaces between the flues may be made as narrow as half an inch, without the slightest danger of a deposit of salt occurring, or of the water being blown out of them. We wish he may get it.

Metallic Woollen Coverings.—Among the many curious attempts to apply the electrotype process, few seem more strange than one which has recently received the sanction of Her Majesty's letters patent for depositing metal on cloth, canvas, pasteboard, or any fibrous substance, to serve the purposes of covering roofs, ships' bottoms, and floors. The inventor seems to contemplate the deposition of metals within the texture of the cloth, as well as on its surface; for which purpose he grinds the plumbago very fine, agitates it in water, and then steeps or boils the fabric in it. The inventor avails himself of any of the known modes of depositing metals from their solutions by voltaic agency; he also claims some methods of his own, by which a more perfect contact with the metal may be obtained; and in case all fail, he also reserves to himself the power of weaving thin metallic wires into the fabric, to fasten the metal coating. It is possible that, for some purposes, canvas or pasteboard, covered with metal, may be available, though certainly not as substitutes for the metal itself, in circumstances when friction, or wear and tear, are to be considered. Ships' bottoms covered with plated pasteboard, would, we imagine, be shortly denuded, and be in a far worse condition than if merely pitched and tarred. The plan of electrotyping the ship itself, which we lately noticed, seems much more feasible.

A new Aerial Machine.—Mr. Monck Mason, who has distinguished himself by several flights through the air in Green's balloon, and who lately published thirteen quarto pages in a contemporary periodical, to prove that Henson's plan of flying was not the thing, has come forward with his own plan for navigating the atmosphere. The scientific world was invited to witness the experiment at Willis's rooms for one day only; and there was shown an elongated body, inflated with gas, which was propelled by means of an Archimedean screw propeller, moved by a powerful spring. It was, indeed, little more than a repetition of Mr. Green's attempt to guide balloons, exhibited some years since at the Polytechnic institution, with the advantage of larger vanes and a stronger spring. We believe the inventor himself has not yet determined what power he will employ to propel the screw; but be it what it may, whether existing or to be invented, it cannot propel the balloon against the wind, nor through the air, without tearing the fabric to pieces. We had rather try Henson's wings, in mounting into the air, than a propelled balloon; the former cannot do much mischief, whilst the latter might raise us higher from the ground than it would be safe to fall.

New Plan for Propelling Ships.—It is not often that we hear of Spanish inventions, and some of those on record do not promise much from that quarter. The most notable project for flying emanated from Spain, which even surpassed those of Mr. Henson and Mr. Monck Mason in its strange application of power; inasmuch as the projector expected to sustain the machine in air by a large piece of excited amber fixed to the top, and to propel it by means of pipes through which the wind was directed against sails, or, in default of wind, by bellows acting against the sails. The Spanish engineer's plan for propelling ships would not, we imagine, be much more practicable. He proposes to have an endless chain attached to wheels of twenty or thirty feet diameter, which are to be worked by manual labour; and he calculates that a few of the crew, with the aid of this apparatus, would be able to work a ship of a thousand tons through the water. It appears to be but a poor substitute for oars, which would be a better application of manual labour than turning these large wheels.

Plating with Molten Metal.—A method of plating iron and sheets of other metal by passing them through rollers in contact with the plating metal in a melted state, has been recently patented by Mr. Edmund Morewood. The plan he adopts with iron is to coat it first with tin, by steeping the plates in a solution of muriate of tin, small pieces of granulated zinc having been previously scattered between each plate. The tinned plates are then made to pass through iron rollers, which are kept immersed in the melted metal with which it is intended to coat the iron. By this plan the process of plating, it is said, may be much more expeditiously performed, and the adhesion of the plated metal is greater.

Art. XIV.—ANALYSIS OF BOOKS.

Compositions from the Liturgy. By John Bell, Sculptor. London: Longman and Co. 1843.

These compositions are chaste and beautiful, and do Mr. Bell much credit. There is a calm placidity about the greater number of the personages represented, calculated to awaken the best sympathies of the soul, and heighten the spirit of devotion. The last composition of the first number, " Deliver us from evil," is an exceedingly striking and energetic production. The whole of the designs are admirably executed in the mechanical department. It appears that they are lithographs, but the lines have all the fineness and decision of copperplate.

Polygraphia Curiosa, or Book of Initial Letters and Ancient Alphabets. London: David Bogue. 1843.

The purpose of this work is to furnish ornamentalists, and persons curious in the antique styles of writing, with specimens of the letters used in the illuminated manuscripts of former days; and this purpose it effectually fulfils. Many of the specimens are very beautiful, and all of them are interesting. The work is printed in gold and colours.

A SURVEY OF THE PERIODICALS.

The Magazine of Science, and School of Arts.—This is a monthly compendium of miscellaneous matters either directly or indirectly connected with science. Without hazarding much that is new, or even original, it collects information from various sources, and often illustrates its subjects with well-executed woodcuts. Its title might, perhaps, excite expectations that would be disappointed, for the work has no pretensions beyond an elementary publication; and the inventions and discoveries it records are not so recent as they might be made by active compilation from other sources. The magazine is, however, printed on good paper, is respectably got up, and sold at a low price.

The Penny Mechanic and Chemist.—This periodical is similar in its main features to the foregoing. Its externals are not so inviting, but it contains a greater quantity of original matter. Among other inventions, it describes, and illustrates with a woodcut, " Davies's improved steam-engine;" the improvement consisting in communicating motion from the piston-rod to the fly-wheel by means of a ratchet-wheel and toothed rods. This plan has, however, neither novelty nor improvement to recommend it; for it has been before attempted, and is but a poor substitute for the crank. The contrivances adopted by Watt, for converting a reciprocating into a rotary motion, were not for the purpose of improving on the crank, but for obtaining the advantage of the crank action without infringing the patent granted for its application. The *Penny Mechanic* boasts that it is " the cheapest scientific work published;" it certainly costs less than most others, and to that fact the boast should be limited.

The Artist and Amateur's Magazine, No. IX.—There is at all times a vast deal of pretension about this periodical, edited by Mr. Rippingille; and in this number he undertakes, with even more pretension than usual, to settle the long-disputed question, What is Beauty? The title of the article is, " Beauty: an Original Hypothesis;" and we are told that its object is " to prove that beauty has a real and *material* existence, in opposition to those theories which hold that beauty is *immaterial* and associative." Never was promise more sadly disappointed than in the attempted fulfilment of this object. The difficulty is to make out what the writer would be at. There is a great deal of pompous verbiage, and very careful circumlocution, as if the writer were afraid of startling us too much by the sudden discovery of his great secret; yet, after all this beating about the bush, we arrive at—absolutely nothing! All that we collect from the perusal is this, that the term *beauty*, like the term *sweet*, is generally applied in a figurative sense; that, in the expressions, " a sweet child," " a sweet temper," " a sweet song," we do not actually mean that the child, the temper, or the song, taste like sugar, though they have reference to the pleasing sensations produced by tasting that substance; in the same manner, in the expressions " a beautiful woman," " a beautiful sound," " a beautiful thought," the term beauty has a figurative relation to that which is in the " highest degree pleasing to sight." We are left, however, altogether in the dark as to this standard of beauty; and, instead of having the material object pointed out or defined, we are told that the term, as generally used, is merely figurative—and with that we must rest satisfied, if we can. The short and long of the whole appears, indeed, to be this—every thing is beautiful which pleases the eye; or in other words, every thing is beautiful that is beautiful!

The Gardener's Magazine, and Register of Rural and Domestic Improvement. No. XII. Conducted by J. C. Loudon, F.L.S., &c., &c., &c.—There is much virtue in a name; and as the name of Loudon, with the list of initials added to it, has obtained great reputation, the "conductor" of this magazine seems desirous to try the efficacy of literary renown alone, in giving value to the present number of his publication. Gardeners, it is true, cannot do much at this season of the year out of doors, but that affords no excuse for so beggarly an account of articles as the December number of the *Gardener's Magazine* presents. But, as if the subject was altogether exhausted, and as if the nineteen pages of matter (which, with the exceptions of index, titles, &c., compose the whole number) could not be filled up with affairs of domestic improvement and vegetable physiology, we are supplied with an article on "Phrenology for Gardeners." The article is a droll one in its way. It teaches gardeners out of place to select for their masters gentlemen with broad chests and high foreheads, and not much exceeding the middle size, whom they will find more generous and less exacting. It gives them particular instructions to observe the same discretion in the choice of a wife, who must have the additional requisite of small hands and feet; for "nothing good is to be expected from an uneducated woman, unless she has an ample chest and attenuated extremities." The forms of Venus de Medicis, and of Apollo Belvedere, are those particularly recommended for a wife or a husband; and rude abortions of those models are cut in wood, and printed in the *Gardener's Magazine*, as guides for choice. The writer, however, recommends that full-sized statues of those naked figures should be placed in every garden, and in the hall of every gentleman's house, and that plaster casts of them should be on the chimney-piece of every cottage, as a *beau ideal* for an object which the writer specifically names. We perceive by a note at the end, that the "conductor" is unwell; which may be some palliation for these strange doings and shortcomings in a generally respectable publication; but surely the public would not bear many such experiments on their purses and their patience, even though the name of Loudon figure on the title, and the form of Apollo Belvedero be stamped on its pages.

[Since the preceding notice was written, we have heard with much regret of the death of Mr. Loudon. His numerous works on botany, landscape gardening, and rural designing, have tended greatly to extend the knowledge of those subjects, and to cultivate a taste for rural improvements; the effects of which are manifest through the length and breadth of the land.]

Blackwood's Edinburgh Magazine, No. CCCXXXVIII.—We have but little to say to *Blackwood* this month. With the exception of a review of Fuseli's lectures at the Royal Academy, and "Something about Music," he is occupied with magazine tales and adventures.

The Literary Gazette and Journal.—The monthly Part of the *Literary Gazette* presents, independently of its reviews of all new publications, a collection of scientific and artistical matter from most parts of the world, and from among which many new facts may be gleaned, and prevalent opinions gathered. There is at present considerable apprehension in the architectural world, that the new façade of the British Museum will prove an abortion; and the secrecy of the proceedings tends to confirm the opinion. The *Literary Gazette*, speaking after having seen the designs, says the façade will not only be a disgrace to the metropolis, but to Bloomsbury. "A senseless portico and colonnade, flanked by projecting wings, and exhibiting some sixty-four Ionic columns, at war with every architectural feature around, is but a public exposure of the ridiculous. But, to accomplish this feat, the whole interior is sacrificed to rooms, on a gallery not deeper than fifteen feet, without light, and condemned, instead of spacious and well-lighted chambers, to be the cells belonging to this absurd front of the British Museum."—We learn from the Paris correspondent of the *Gazette*, that specimens of the wood from the oldest and largest roofs of the cathedrals in France have lately been submitted to the examination of the botanical professors at the Jardin des Plantes, who have decided that the wood is oak, and not chesnut, as was previously supposed. Its freedom from worm is attributed to long seasoning before use, and to the roofs being protected from rain; at the same time that they are freely ventilated.—The Editor of the *Literary Gazette* seems to be much taken with a stone coffin he had been invited to look at by Mr. Johnson. The plan, we suspect, is not so new as the *Gazette* seems to imagine; and we much question whether any kind of stone will be found impervious to decomposed animal matter.—Mr. C. Ellis has selected the *Literary Gazette* as a medium for announcing to the world his discovery of "a new motive power," which, we are informed, is capable of unlimited extension, and may be maintained at a cost so trifling as almost to amount to a self-maintaining power. The inventor contents himself at present with mentioning some of the effects *to be* produced; but he promises, as soon as the patent has been secured, to furnish an ample description. We are told that, by the application of this power, "vessels may be navigated to India and back at a cost perfectly insignificant, and at a speed equal to anything that has hitherto been accomplished by steam. It is controlled and managed with a facility truly surprising, even when worked at a very great pressure, and, under all circumstances, entirely free from danger. It is equally applicable both to the paddle-wheel and the screw; but the steam-engine, boiler, and coals, are dispensed with altogether." We have been so accustomed to hear of new self-generating moving powers, and to witness their failures in practice, that Mr. Ellis must excuse our being less sanguine than himself of the realisation of all these promised wonders.

The Athenæum, Journal of English and Foreign Literature, Science, and Fine Arts. Part CXCI.—This periodical, founded on the model of the *Literary Gazette*, is much graver and more severe than its older and dearer contemporary. Some there are who charge it with being ill-tempered to all but a select few; but we have not to deal with humours, but with its records and facts, of which it contains a large store. A discussion has been carried on in the pages of the *Athenæum* between Sir J. Herschel, and Dr. Robinson of Armagh, in consequence of the latter having stated, at the general meeting of the British Association at Cork, that Sir W. Herschel's great telescope was a *failure*. The Doctor should have been more careful how he spoke the truth in a matter relating to a great man, whose greater relative exists to defend his fame. Dr. Robinson appears to be annoyed at the defence, but he nevertheless maintains his ground; and he shows that, compared with the expense and the means available, the results were very short-coming, and that he is justified in calling the telescope a "failure." Sir John contends that we ought not to judge of the success of the telescope by comparing it with the works of modern times, which have the advantage of the vast improvements in science and art that have since been made; but granting this to its full extent, it nevertheless appears that no celestial body was seen with Herschel's large telescope that could not have been detected with other instruments then constructed; and that Sir W. Herschel seldom used the leviathan himself, and never permitted any one to look through it but the King, who had provided the funds for its construction, and one or two favoured individuals.—The attempts that are now making to revive the adoption of tesselated and Mosaic pavements is warmly supported by the *Athenæum*, and the different modes adopted for bringing the improvements of modern times to bear effectively on the manufacture of such pavements, is considered at some length. Mosaic tiles are now manufactured at a cost that renders such pavement economical in public buildings, where many persons are constantly passing. Even in the halls of private houses, mosaic pavement may be laid down with advantage, economically speaking; and in point of decorative beauty, there is no comparison between the Mosaic pavement and the painted floor-cloth.—In an article on metropolitan improvements, the subject of a better water-supply, especially in comparison with what has been lately done by the people of New York, is taken up, not, however, with a view to show how a better supply may be obtained, but merely to enforce the necessity of something being done. There appear, indeed, to be active attempts making to improve the health as well as the beauty of the metropolis; and we hope this most important of all considerations will not be neglected. The *Artizan* has already shown whence an ample supply might be procured. We may observe *en passant* that a correspondent of the *Athenæum*, signing himself "J. A. Borron," who says he witnessed the greater part of the progress of the Croton aqueduct, speaks of it as having failed to answer the expectations of the engineers, and that the quantity of water delivered at New York, and collected in the reservoirs, is much short of the calculated quantities, and the level to which it can be supplied is also considerably lower.—Among the foreign scientific memoranda of the *Athenæum*, we notice that the city of Milan, where the next meeting of the Scientific Association of Italy is to assemble, has granted 10,000 Austrian livres, "to be expended in one or more grand experiments within the region of the physical or natural sciences, to be made during the meeting of Congress." The experiments are to be recommenced by the Italian *savans*, and the selection to be determined by a committee. When will any of our large towns be found imitating so munificent an example for the promotion of science?

Fisher's Colonial Magazine.—The importance of our vast and extending colonial possessions well entitle them to the distinction of having periodical publications devoted to their interests. *Fisher's Colonial* is among the best. The present number contains a variety of matters of fact connected with our South Australian possessions, which give it a value to all readers who care for the welfare of their distant countrymen, struggling into a state of civilization and comfort. The great want in Australia has hitherto been a means of rendering the superabundance of live stock available. When a sheep is sold for two or three shillings, which is not an uncommon price in New South Wales, the sheep grazier looks with a longing eye towards the markets of England for the sale of his mutton; but the world interposed stops the view, nor does steam offer much aid to cheapen the distance. To bring over the animal alive is impracticable, and we have not yet acquired a relish for mutton-bacon and hams. The colonists have, therefore, adopted the same plan with their sheep which the Americans have commenced with their hogs,—they boil them down into tallow! In this form they become easily transportable and saleable, and the quantity of fat yielded is said to be sufficient to raise the value of the carcase to five or six shillings as the *minimum*. The legs are cured as hams; and, if properly introduced in this country, would, no doubt, be approved. But this is not all; a salting company on a large scale has been established at Sydney; and experiments having proved the colonial salt to be equal to that from Liverpool, a new field of enterprise is thus opened to the colonist, whose live stock becomes converted by salting into current cash.—An article on emigrant ships, written by one who had the charge of a cargo of bounty-emigrants from Cork, shows forcibly the want of proper regulation with which the process of free emigration is conducted. The experiment of exporting able-bodied labourers at the national expense, to our colonies should be conducted with great caution, to prevent failure by the improper selection of emigrants; and it appears that much is wanted to render the arrangements satisfactory.—There is a comprehensive account of New Zealand and its present state, in which the history of the colony is sketched from its discovery to its recent colonization. The prospects it presents to the emigrant are depicted as being most encouraging.

Tegg's Magazine, No. VIII.—An article under the head of "Chemistry for the Month" is devoted to phosphorus, its manufacture and properties. The description of the mode of making phosphorus is clear and scientific. In the year 1796, Gahn discovered that it was contained in bones in union with lime; Scheele soon after contrived the following process, by which it is now obtained from this source: "The bones are calcined (to destroy the animal matter) till they become white, in which state they contain phosphate of lime, with a little carbonate of lime. This substance is then decomposed by about two-thirds of its weight of sulphuric acid; to this is added water, and the insoluble sulphate of lime precipitates, and is separated by filtration from the super-phosphate of lime in solution: this liquid is then evaporated to the consistency [consistence] of a syrup, when it is intimately mixed with powdered charcoal, to form a thick paste; it is then well melted in a mortar, and having been dried in an iron vessel, it is introduced into an earthenware retort, the beak of which is immersed in water; the heat is gradually raised, till the retort is heated to whiteness. During this process gaseous bubbles issue from the beak of the retort, some of which rise to the surface of the water, and take fire; at last a substance, having the appearance of melted wax, drops from the beak of the retort, and congeals in the water;—this is *phosphorus*, the formation of which depends on the union of carbon with oxygen at a high temperature. These two gases unite, and form carbonic oxide; consequently the phosphorus is all along accompanied with that gas." It may not be without use to observe that phosphorus is exceedingly poisonous, even when taken in small quantities, as it undergoes combustion in the stomach.

Repertory of Patent Inventions, No. XII.—This number contains the specifications of eleven patented inventions, which is less than one-third the number of patents usually taken out each month, so that two-thirds are excluded from notice in this Repertory. Even of those noticed, some are more than a year old. Nor is it that the selection is made with reference to the importance of the inventions, for among those selected are inventions for cutting out gloves, and for making candle-wicks. A periodical having for its object the publication of the specifications of patents should comprise a notice of all patented inventions, and those the most recent. As it is, the publication is imperfect and costly.

The London Journal, and Repertory of Arts, Sciences, and Manufactures, No. CXLIV.—This older periodical, of the same character as the preceding, still more imperfectly fulfils the expectation of its title. It contains, indeed, abstracts of specifications of seventeen patents, but scarcely one of them is new, and many of the patents were sealed so many years ago, that perhaps even the inventors themselves may have forgotten them. There was lately a "lull" in the inventive world, and but comparatively few patents were taken out; we are glad to perceive that this inactivity is now succeeded by an unusual vivacity, for within the period from the 27th October to the 21st November, little more than three weeks, the great seal was called into requisition forty-four times by enterprising inventors.

The Gentleman's Magazine, Vol. XX., No. VI.—The correspondents of the venerable "Mr. Urban" seem beside themselves with the exciting controversy respecting the forms of churches as adapted to the innovation of "Puseyism." The question of low chancels and high chancels is taken up with great warmth. With their disputations on religious grounds we have no intention to interfere; but we trust that the excitement will at all events have the effect of directing more attention to the beauty of church architecture. A correspondent at Cambridge mentions the completion of a small cemetery chapel there, which is regarded by the architectural connoisseurs as a fine specimen of Gothic, "which exhibits the true spirit and gusto of the style." The architect of the chapel is named Lambe, and his work is said to have also the rare merit of being effected with very limited means.

ART. XV.—MARVELS OF THE DAY.

New Light for Mines.—A correspondent of the *Mining Journal* suggests the use of the electrical light lately noticed in the ARTIZAN as having been tried at Paris, for lighting mines with the view of obviating explosions. The electrical light does not consume air; and a light of this kind might be insulated in a glass globe, so as to have no connexion with the fiery atmosphere of the mine. In our eyes the application promises to be highly important.

Perpetual Motion at last!—In the last number of the *Chemist*, Mr. Reuben Phillips announces his belief that he has succeeded in resolving nitrogen into carbonic oxide, so that in the atmosphere itself we have an inexhaustible supply of fuel! We must confess ourselves to be very incredulous of these grand discoveries: at all events, we think Mr. Phillips might have kept the matter to himself until he had *proved* the identity of the substances in question.

FROM OUR OWN CORRESPONDENTS.

GLASGOW.—*Iron Foundries.*—Most of the iron-founders here have got their hands full; and, judging from the quantity and quality of the work issued, the trade might be pronounced in a state of enviable prosperity. While, however, the low price of iron has increased the demand for castings, the competition among manufacturers has lowered *their* prices in a greater than corresponding ratio; and the combination among the workmen, to keep up the rate of wages, tends still farther to make the business less remunerative at present than ever before.

The iron-moulders' union has long had the reputation of being one of the stanchest and best organized among operative confederations. Originating, or professing to originate, like all similar associations, in the commendable design of self-defence against the urgency or the aggression of employers, it has grown at length to be oppressive, if not odious, to many of its own members. It has hitherto baffled the most strenuous attempts at coercion; and has by turns terrified, tormented, and even ruined, the ill-advised capitalist who may have had the hardihood to provoke its resentment, without the power to quell or to crush it.

A shrewd and consistent selfishness, when combined with resoluteness, if not a sublime affair, is at least a very passable and respectable sort of a thing; but even such equivocal commendation cannot, alas! be bestowed unreservedly upon trades' unions. It is a humiliating truth, that such associations have hitherto frequently borne too faithful a resemblance to a congregation of scorpions secluded under one receiver; though their venom may, at a chance time, be squirted from their prison, and may scald or scathe the passers-by, it is not so hurtful to those without, as it is noisome and noxious to themselves.

Gas Works.—The recently constituted City and Suburban Gas Company are prosecuting their works with vigour, under the management of their experienced engineer, Mr. Bartholomew, whose recent connexion with one of the most extensive and best appointed gas-works in England qualifies him to introduce such improved arrangements as have not hitherto been adopted in this country. The application of self-regulating governors, or exit-valves, to preserve an equal pressure in the pipes, is one of the most obvious and most useful of these. The medium and smaller sizes of pipes are bored and turned in the faucit and spigot ends (being made slightly conical); the advantage of this lying in the great facility it gives for making the joints, in laying or re-laying the pipes. These are of much greater weight than those ordinarily used: a judicious proceeding, even apart from the financial consideration of the unprecedented cheapness of the material.

We had occasion, the other day, to notice a method of obtaining a strong, powerful light—where the more effective illuminators are too troublesome or too delicate,—simply, burning the common gas or cannel coal in a suitable basket, at a proper height. As the price, in Glasgow, of that coal is 15*s.* per ton, and one ton may, by proper management, give as much light as 4 cwt. to 5 cwt. of tallow candles, some idea may be formed of the cheapness and efficiency of such a light.

Smoke.—Stringent measures are again in contemplation by the Town Council, for coercing the smoke manufacturers of Glasgow. We begin now to get a glimpse of the true solution to the query, "Why does so little come of all the civic fulminations that are hurled from time to time against the offenders?" and come to have as great faith in the virtue of their denunciations as we should have in the impartiality of a jury of *Reynards* admonished to return a conscientious verdict on one of their brethren charged with the manslaughter of a turkey.

River.—The diving-bell has been at work for some time in the neighbourhood of Glasgow Bridge, co-operating with the channel rakes or scrapers, in removing the stones, &c., from the side of the quay. The piled quay frontage, between the bridges, is now affording berths to sundry small craft; that part of the harbour being completed.

LIVERPOOL.—*The Nimrod.*—This vessel, built by Messrs. T. Vernon and Co., of Liverpool, has recently made her first trip, and promises well. The following are some of the principal dimensions:—

Length, from figure-head to taffrail	200 feet.
Ditto between perpendiculars	180 „
Ditto of keel	175 „
Beam	26 „
Width over paddle-boxes	46 „
Depth of hold	16 „

By the old measurement, 591 tons.

The "Nimrod" is intended for the Liverpool and Cork trade. The hull, paddles, and deck beams and rudder, are of iron; she is clinker-built to the water-line, and the remainder is carvel-built; she has four water-tight bulk-heads, which divide the interior into five compartments. The bottom frames are 15in. deep, and well strengthened with angle-iron. The quarter-deck is 55ft. long, and the principal saloon 41ft. long, and 8ft. high; the number of berths is 50. The whole arrangement of the cabins is good, and the fittings and decorations in good taste, and what, ten years ago, would have been considered very magnificent.

The engines were constructed by Messrs. Bury, Curtis, and Kennedy, and are of 300 horses' power. They are of the direct action variety, arranged in the form represented as Messrs. Bury's, in the large engraving of direct-action engines lately given away with the ARTIZAN. The space occupied by the engines and boilers is only 35ft. 10in.; diameter of the cylinders, 66in.; length of stroke, 63in.; diameter of wheel, 24in. 6″; breadth of float, 8in. 6″; depth, 2in. 7″. There are two cylinders, and only one air-pump, which is double acting, 37in. diameter by 2in. 7″ stroke. The air-pump is situated between the cylinders, and is worked by a crank on the intermediate shaft.

Speaking generally, the "Nimrod" is a vessel that does credit to the material of which she is built. She looks well on the water; promises to be a good sea-boat; goes fast; and carries a very large cargo. This we can say honestly, and we say it with pleasure; but we do not think it is well, when such rapid strides are making in steam navigation, merely to pay compliments: we ought to point out what we in our humble judgment consider to be defective, as the only sure means of arriving at still greater excellence.

The objections we make are these:—The lines of the vessel are not quite what they ought to be. We suppose this may be attributed to the too common practice of yielding to the prejudices of the owners, or of not obtaining the assistance of really scientific men. A square chest, finished at the ends with fine lines, is surely not the only model from which vessels should be built. There will be a shoulder somewhere, and the speed will suffer accordingly. Again, the vessel is crank or top-heavy. This is, in some measure, to be attributed to her form, being very wall-sided, and to the great height of the engines, boiler, and coal-boxes. Now, was this all necessary? We say not. No man must, in these days, say he was obliged to make one defect to avoid another. Here, again, we think we see the amateur's hand:—he is told that a long stroke is absolutely necessary to insure speed; and the engineer, to comply with his wishes, makes the whole too lofty. Surely, also, some better arrangement might be made without losing stowage to keep the boiler and coals lower. Iron vessels, in general, are very stiff, and will in general bear having sponsons, which greatly increase the capacity of carrying, cattle; but the "Nimrod" has no sponsons, and yet is far from being a stiff vessel.

Now one word of advice to Thomas Vernon and Co. The iron work, although no doubt strong, is not neatly finished. We can easily assign one cause for this—the vessel was built too fast. Four months and twenty days is not time enough. We cannot see any merit in this extreme haste; and heavy work can never be satisfactory unless proper time is taken. Let the builders take this hint, and not be forced into the commission of such errors for the future. We believe they can do and have done better, and we trust they will do so again.

"The "Nimrod" has made one voyage to Cork, during which she had two accidents, which have given rise to the impression that something was wrong; and, on this as on all similar occasions, the Solons of the press, and sundry rival engineers, have not been backward in making the most of the derangement, leaving impressions on the mind of the careless inquirer prejudicial to the builders of the engines. As faithful journalists, and the friends of the craft, we are bound to stand forth, and, as far as we are able, to protect the interest of those who appear to us to be unfairly dealt with. We have before pointed out what we conceive to be the defects in this vessel, and we have spoken plainly; but when we see trifles magnified unnecessarily, through malice, we shall be equally plain in exposing the fraud.

Now the truth is this. The air-pump having a solid plunger, and being double-acting, has the same duty to perform in the lower stroke that *all* air-pumps have in the upper, viz., to force into the hot-well, and against the atmosphere, a certain quantity of water, which has to be pumped from the condenser. To the bottom chamber of the air-pump is generally attached a valve, by some called the "tail-valve," by others the "snifting valve." This valve is used in clearing the condenser of water before starting; and, in the ordinary plan, being in connexion with the condenser, it is kept closed by the pressure of the atmosphere; but, in the double-acting pump this is not the case, as we have before shown, but the valve is liable to be lifted at each downward stroke, and some portion of the water to be thrown out. Mr. Kennedy was well aware of this, and had designed that a weight should be placed upon it; but the arrangement being an unusual one, and the object of it being probably not understood by the men, the weight was omitted. The result may easily be anticipated—the water began to rise in the engine-room, and no one could discover the cause. It was thought that the vessel was leaking, or that some of the pipes were broken; and the vessel was, in consequence, from prudential motives, turned into Holyhead. It is needless to say that the cause was soon discovered, and a lead weight cast and put upon the valve. On returning from Cork, we believe that one of the hot-wells was cracked; and, with the view of taking the pressure off the hot-wells, larger waste-water pipes are to be introduced,

We may thus see how mere trifles become stupendous imperfections when seen through the medium of jealousy: but we trust no one will, from such causes, attach blame to Messrs. Bury, Curtis, and Kennedy; nor, from an unfair version of a trivial mistake, endeavour to lessen the reputation of the last of these gentlemen, as one of the ablest engineers this country has produced.

We feel, however, that the builders of the engines of the "Forth" and the "Medina," belonging to the Royal West India Company, need no commendation from us. We have, as honest journalists, merely endeavoured to place things in their right light.

ALEXANDRIA.—I received, only by this month's ship, the promised numbers of the ARTIZAN. I know, from its class, as well as from its quality, it is such a work as will *take* among our English residents. Of course, in a very limited population, the consumption cannot be very extensive; yet I think, in this country, it will be generally read, and, indeed, has already won numerous admirers. More of this, however, with the list of subscriptions, by next mail.

I am positively ashamed to say I have not managed, as I promised, to get up any matter on the subjects you prescribed. It is difficult, exceedingly difficult, in *this* country, to get fully at facts; as, in a body of artizans employed on the various parts of a work, you require almost to know as many languages as there are men, to get from each an idea of its practical character—and hence one obstacle. But I hope, with a little leisure, to get hold of an intelligent civil engineer, who has had great experience as well as great influence in Egypt, and I will put him under contribution for things I cannot obtain myself. It will be interesting to know, that the question agitated some time ago for improving the means of transit between Cairo and Suez, by re-opening the ancient canal, formerly supposed to connect the Mediterranean and Red Seas with the Nile, and which was tendered for by the Austrian Government, is again confidently spoken of in well-informed quarters as about to be brought to an issue. It is known to the writer, that the Pacha of Egypt is at present seriously entertaining the question whether the laying of a railway, or opening a *direct* canal between Cairo and Suez, would be the more conducive to the furtherance of commerce. The line of canal contemplated in the survey made by some Austrian engineers some time since—that is, direct from Suez to El Arish—has been abandoned, in consequence of the want of a safe harbour on the Mediterranean side; and the question has now resolved itself into, whether a direct canal across the Desert, forming a junction with and obtaining its supply from the Nile, or a railway, will best answer the purpose contemplated. The latter has been entertained for a long time; but there are these objections to it:—First, that a larger outlay of capital in machinery would be requisite; a larger cost of maintenance must be incurred; and it would be more subject to interruption if found to interfere, as it most certainly would, with the established traffic of the Desert Bedouins. That it is practicable, no one who knows the locality can for a moment doubt;—that it would be constructed at a less expense than any other existing railway, may be easily imagined, when it becomes known that there is, with two trivial exceptions, a level gravelly surface between the proposed termini, rising in few places, save those mentioned, with a greater ascent than about 1 in 150; or, I should be quite as near the truth in saying, 1 in 180 or 200 feet. Besides, there is no ground to be purchased; there is abundance of stone and lime for raising the road-way where the surface is sandy; and be it known to such as may not be conversant with the character of this desert, that *this said sand covers the hard surface in no place to a depth of more than five or six inches*—it being only drift. Again, the arguments in favour of a direct canal, are, the advantage of irrigation; the vast tract of desert that must be reclaimed if such a supply of water passed through it; for it has been proved beyond dispute, that, arid and dreary as these wastes appear—to become productive, *luxuriantly* productive, it is only necessary to introduce a supply of water. The geological character is, notwithstanding the sandy appearance, decidedly argillaceous, with extensive beds of *Calcaire Grossier* (a coarse kind of limestone) and siliceous sandstone; which, becoming incorporated with the alluvium of the river, and supplied with water, has been proved, by every-day encroachment, to be extremely fertile. The difficulty, the great difficulty, I imagine, will be found in obtaining a supply of water, if it is found impracticable to carry through the level from the Nile. The whole eighty miles of surface cannot, of itself, furnish a single pailful. The relative saving, however, if this difficulty can be got over, in the construction of a canal, will be, that labour (a cheap commodity to His Highness) can be substituted for capital—that is, the cost of railroad machinery, the expense of foreign artizans, and the sundry other requirements of a costly work of this kind. The gain is obvious, in the reclamation of immense extents of productive land, and the consequently vast increase in the national produce. It is contemplated the canal may be completed, by the aid of 100,000 men, (which are always available at a week's notice), within six months!

I mention these facts because I believe it is the old man's feeling that some gigantic effort of this kind is necessary as a climax to his fame, so that posterity may look upon Mehemet Ali as a prince not unworthy to have lived in and represented the kingdom and greatness of the Ptolemies. I mention them because I believe one of the two projects *will be* accomplished; because I conceive *both* practicable; and because I am of opinion that the completion of either would do more to advance the interests of British commerce with the East, by reducing the difficulties of intercourse, and by enlarging the means of traffic, than any other project short of steam-communication itself. I mention them because I know the result would benefit Egypt, not merely in physical production, but that, in expanding the field of labour, and opening the channels of intercourse, you open also men's minds; and I judge very inaccurately of the Arab character, if the moral development, which it is the property of increased intercourse to accomplish, would not thus acquire an impulse which would lead them from one stage of enlightenment to another, until curiosity issued in civilization. D.

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